AD-769 941

MAINTAINABILITY ANALYSIS OF MAJOR HELICOPTER COMPONENTS

Thomas N. Cook, et al

Kaman Aerospace Corporation

Prepared for:

Army Air Mobility Research and Development Laboratory

August 1973

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

i

Unclassified
Security Classification

AD769941

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Kaman Aerospace Corporation Old Windsor Road Bloomfield, Connecticut	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

MAINTAINABILITY ANALYSIS OF MAJOR HELICOPTER COMPONENTS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final Report

5. AUTHOR(S) (First name, middle initial, last name)
Thomas N. Cook
Robert L. Young
Frank E. Starses

6. REPORT DATE August 1973	7a. TOTAL NO. OF PAGES ~~314~~ 316	7b. NO. OF REFS
8a. CONTRACT OR GRANT NO. DAAJ02-72-C-0065 b. PROJECT NO. Task 1F162205A11905 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) USAAMRDL Technical Report 73-43 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Eustis Directorate U.S. Army Air Mobility Research & Development Lab., Fort Eustis, Va.

13. ABSTRACT

This report examines the factors responsible for the high man-hour cost of maintaining current-inventory Army helicopters. Major components of six helicopter models were analyzed to identify the significant man-hour consumers on each aircraft.

The study was accomplished in three phases. In the first of these, historical maintenance data was gathered, processed and analyzed to assess the overall man-hour requirements on each helicopter. This analysis identified the significant man-hour consumers on each aircraft in terms of discrete types of maintenance and failure modes, the frequency at which specifically defined tasks occur and the average man-hours expended on each task. In the second study phase, the maintenance actions identified as high man-hour consumers via the foregoing analysis were then subjected to a detailed engineering analysis of maintenance task time. In the third study phase, field surveys were conducted at a number of Army aviation maintenance activities operating and maintaining the six helicopter models under study. The surveys were used to compare the analytical findings with the judgement of experienced Army maintenance specialists in the field and to gain a deeper insight into the maintenance requirements of the various aircraft. Using data derived from the analysis, a checklist has been developed for use in maintainability analyses of future helicopter designs.

DD FORM 1 NOV 65 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

Unclassified
Security Classification

14.

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Component Repair and Replacement Statistics						
Design Considerations						
Helicopter Maintenance						
Maintainability						
Maintainability Guide						
Maintenance Requirements Analysis						
Maintenance Task Time						
Major Helicopter Components						
OH-58						
OH-6						
UH-1						
AH-1						
CH-47						
CH-54						

DISCLAIMERS

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission, to manufacture, use, or sell any patented invention that may in any way be related thereto.

Trade names cited in this report do not constitute an official endorsement or approval of the use of such commercial hardware or software.

DISPOSITION INSTRUCTIONS

Destroy this report when no longer needed. Do not return it to the originator.

A

ic

DEPARTMENT OF THE ARMY
U. S. ARMY AIR MOBILITY RESEARCH & DEVELOPMENT LABORATORY
EUSTIS DIRECTORATE
FORT EUSTIS, VIRGINIA 23604

This investigation is one of a series being conducted on current Army helicopter maintenance operations by the Eustis Directorate of the U.S. Army Air Mobility Research and Development Laboratory.

The effort was performed by Kaman Aerospace Corporation under the terms of Contract DAAJ02-72-C-0065 and was directed at analyzing those factors responsible for the high consumption of maintenance time in the performance of maintenance actions. The analysis was performed on current-inventory Army helicopters. The report provides an insight into the man-hour expenditure as it relates to the maintenance task function. The data derived during this effort was developed into a checklist having potential usefulness in measuring the maintainability of future helicopter designs.

It is believed that the results of this investigation will not only develop better understanding of design characteristics which complicate helicopter maintenance, but will also provide direction for reducing similar complications in future designs.

The technical monitor for this contract was Mr. William B. Sweeney, Military Operations Technology Division.

Task 1F162205A11905
Contract DAAJ02-72-C-0065
USAAMRDL Technical Report 73-43
August 1973

MAINTAINABILITY ANALYSIS OF MAJOR HELICOPTER COMPONENTS

FINAL REPORT

By

Thomas N. Cook
Robert L. Young
Frank E. Starses

Prepared by

Kaman Aerospace Corporation
Bloomfield, Connecticut

for

EUSTIS DIRECTORATE
U.S. ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LABORATORY
FORT EUSTIS, VIRGINIA

IE

SUMMARY

This report examines the factors responsible for the high man-hour cost of maintaining current-inventory Army helicopters. Major components of six helicopter models were analyzed to identify the significant man-hour consumers on each aircraft. Causes for maintenance were established in terms of failure modes, maintenance frequency, and average repair time. Major component replacement tasks were structured in terms of specific time elements, and important factors affecting maintenance task performance were established.

The study was accomplished in three phases. In the first of these, historical maintenance data was gathered, processed, and analyzed to assess the overall man-hour requirements on each helicopter. This analysis identified the significant man-hour consumers on each aircraft in terms of discrete types of maintenance and failure modes, the frequency at which specifically defined tasks occur, and the average man-hours expended on each task. In the second study phase, the maintenance actions identified as high man-hour consumers via the foregoing analysis were then subjected to a detailed engineering analysis of maintenance task time. Using troubleshooting charts, maintenance instructions and test procedures, supplemented where possible by actual aircraft examinations, experienced technical personnel analyzed each high man-hour task to determine the proportion of total time devoted to specific elements of the task. In the third study phase, field surveys were conducted at a number of Army aviation maintenance activities operating and maintaining the six helicopter models under study. The surveys were used to compare the analytical findings with the judgement of experienced Army maintenance specialists in the field and to gain a deeper insight into the maintenance requirements of the various aircraft.

This report documents the results of the three study tasks. Using data derived from the analysis, a checklist has been developed for use in maintainability analyses of future helicopter designs.

Further study is recommended to investigate the characteristics of helicopter designs contributing to the high man-hour cost of maintenance.

FOREWORD

This maintainability analysis of major helicopter components was performed under Contract DAAJ02-72-C-0065 for the Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory, Fort Eustis, Virginia.

The study was conducted under the technical direction of Mr. William B. Sweeney and Captain Charles V. Spain of the Reliability and Maintainability Division. Major Robert Mangum provided technical advice and assistance to the project.

The authors wish to express appreciation for the excellent cooperation extended by the Army field activities who assisted in this work. The technical competence and professional attitude of the many Army personnel involved was a major contribution.

Preceding page blank

TABLE OF CONTENTS

Page

APPENDIXES

LIST OF ILLUSTRATIONS

Figure

Page

LIST OF TABLES

Table		Page

INTRODUCTION

BACKGROUND AND STATEMENT OF THE PROBLEM

Helicopters typically require greater maintenance than fixed-wing aircraft of comparable size. The reasons for this are widely recognized. First, rotary-wing craft are inherently more complex than their fixed-wing counterparts. Vertical lift capability is not achieved without penalty - it simply takes more systems and equipment to do the job. Secondly, the helicopter is subjected to consistently higher operating stresses. The dynamic systems (rotors, drives, and controls) operate continually at near-design conditions and under high dynamic stress loads. The fatigue life of a majority of helicopter dynamic components is consequently limited, resulting in scheduled replacements and overhauls not encountered with fixed-wing aircraft.

Vibration also contributes greatly to the maintenance problems in helicopters. Components subjected to constant vibration are more prone to failure, thus adding to the maintenance workload. Recent advancements in the technology of vibration isolation and damping promise to make this problem less acute in future helicopters, but vibration is today, and will be for the near future, a significant factor in the helicopter maintenance problem.

Another factor bearing on the helicopter maintenance problem is the normally congested packaging of systems resulting from the unfavorable ratio of hardware to available space. With the constraints on airframe size and weight, space becomes a crucial concern to the designer. The result is often unavoidably poor accessibility for maintenance. More maintenance time is needed simply to get at things, and once there, the task is often prolonged by obstructions and the inability of the mechanic to move freely. Lack of accessibility, although a concern in all types of aircraft, is especially troublesome in helicopters.

The helicopter's operational environment is another important factor in the maintenance problem. Helicopters typically operate close to the ground, which exposes them to a more hostile environment than fixed-wing aircraft. Landing and takeoff from small unprepared fields, hovering over sand and water, moored and unprotected in the elements, exposed and vulnerable to damage from many sources, the helicopter requires greater maintenance than aircraft operating in less harsh environments. The environment also takes its toll in

helicopter maintenance task time. Frequently, the maintenance task must be performed outdoors in the cold, wind, rain or snow with only the most meager facilities. Personnel performance and efficiency consequently suffer.

The problem of helicopter maintenance is of special concern to the Army, since the helicopter is the mainstay of its aviation arm. The Army, therefore, is doing most to identify and remedy the problem. One of the ways in which this is being done is through investigations such as the one for which this report has been prepared. By investigating the causes of current maintenance problems, future designs will benefit from the experience of the past.

The objective of this study has been to quantify maintenance task time in terms of discrete task elements. By establishing the time structure of major maintenance tasks, the elements of work contributing most to the overall man-hour expenditure are identified. Factors of design and support affecting the time to perform maintenance are also established.

In this study, the Army requested an analysis of the maintenance requirements for certain helicopter subsystems and components identified as major man-hour consumers. The generic types of components to be investigated were:

1. Tail rotor systems, including drive shafting, drive shaft supporting assemblies, gearboxes, hubs and rotor blades.
2. Main rotor hubs
3. Auxiliary power plants
4. Stability augmentation systems (SAS, SCAS, AFCS, Etc.)
5. Transmissions and gearboxes
6. Hydraulic servo actuators
7. Starters and starter-generators
8. Swashplates and supporting assemblies
9. Main drive shafts
10. Power plant installations

The analysis was to cover these components on the following types of current-inventory Army helicopters:

1. UH-1 Utility

2. AH-1 Attack

3. OH-6 Observation

4. OH-58 Observation

5. CH-47 Cargo

6. CH-54 Cargo

An initial look at the task posed a fundamental question appropriate to each of the components scheduled for investigation: To what extent are the maintenance man-hours expended on this item due to the frequency of maintenance as opposed to the time required to perform maintenance?

This is a determination of basic importance in an analysis of the maintenance problem. Heavy maintenance requirements are caused, in some cases, by nuisance-type problems which consume little time in correction but which happen much too frequently.

In other cases the frequency of the task may be low, but considerable maintenance time is expended at each occurrence. The result is the same: a heavy maintenance man-hour expenditure. In yet other instances, many man-hours are expended chasing problems which do not exist at all, as when a pilot imagines a "funny beat or shake" (often because of a component's prior reputation for trouble). It was considered probable that each of the components to be studied would involve some combination of these maintenance causes in varying degrees.

In order to arrive at a basic understanding of the maintenance problem, certain items of information were considered to be necessary:

1. High Man-Hour Consumers - identification of the items (components) which consume the largest share of maintenance man-hours.

2. Types of Maintenance Performed - for the items identified as high man-hour consumers, the proportion of maintenance time expended on scheduled replacement, repair of failures, no-defect actions, etc.

3. Frequency Versus Repair Time - each maintenance category applicable to the item analyzed in terms of frequency of occurrence and time-to-repair.

This data would provide the basis for constructing the general dimensions of the maintenance requirement in terms of what is done, how often, and how much time it takes. Having reached this basic understanding of the problem, it would be necessary to next probe for the factors underlying heavy maintenance man-hour expenditures. Additional data would be needed for this:

1. Failure Modes - definition of the item's failure modes to the extent necessary to identify the different types of maintenance tasks performed.

2. Elements of Task Time - the component elements of maintenance task time, e.g., the time required to fault isolate, gain access, repair or replace, test, etc.

3. Factors Affecting Maintenance Time - the factors which contribute to the ease or difficulty of the maintenance task, e.g., access provisions, size and weight of the component, complexity of alignments, adjustments, tests, etc.

All of the above data were considered vital to a complete analysis of the maintenance problem. Without such data the analysis would rest heavily on technical judgement, suffering attendant losses in objectivity and validity.

TECHNICAL APPROACH

The technical approach to the maintainability analysis of major helicopter components involved five principal tasks:

1. Data Processing. Historical maintenance data was processed and tabulated for the various helicopter subsystems and components scheduled for analysis. This was accomplished for each of the six helicopter types included in the study. A substantial base of maintenance and flight activity records, from both Marine Corps 3-M and Army TAMMS sources, was used to assemble the historical data on each aircraft. The

process entailed the classification of maintenance tasks according to structured criteria and the calculation of associated statistics.

2. Maintenance Requirements Analysis. An analysis was conducted to identify the significant man-hour consumers on each helicopter in terms of discrete types of maintenance and failure modes, the frequency at which specifically defined tasks occur, and the average man-hours expended on each task. This allowed the analysts to rank maintenance problem items, to identify underlying causes, and to determine the areas in which further analysis should be concentrated.

3. Maintenance Task Time Analysis. The component replacement actions identified as high man-hour consumers via the foregoing analysis were then subjected to a detailed analysis of maintenance task time. Using troubleshooting charts, maintenance instructions and test procedures from Army manuals, supplemented where possible by actual aircraft examinations, experienced technical personnel analyzed each of the selected tasks to determine the proportion of the total task time devoted to specific elements of maintenance. This involved a very comprehensive, step-by-step analysis of each task. As a result of this effort, all of the selected maintenance actions were documented in terms of specifically defined elements of maintenance time.

4. Field Surveys. The maintenance requirements and task time analyses, just described, provided the basic statistical foundation for the study. Visits were then made to a number of Army aviation maintenance units to examine aircraft and to interview Army maintenance specialists. The purpose of these interviews was to review the results of the task time analysis with experienced maintenance personnel on each model helicopter. Interviews were augmented, where possible, by on-the-spot examination of component installations and

observation of actual maintenance tasks. Through these surveys, the maintenance tasks analysis was verified by Army personnel with "hands-on" experience and modified where necessary. The survey method also provided the opportunity to gain valuable insights into maintenance problems not obtainable through a strict technical analysis alone.

5. Development of a Check List. The knowledge acquired as a result of this study was used to develop a guide for use in maintainability evaluations of future helicopter designs. The guide is maintenance function oriented, directing attention to the tasks and design characteristics which contribute most importantly to the maintenance problems with generic classes of components on current-inventory Army helicopters.

This report describes the methods of analysis, and documents the results, conclusions, and recommendations of the study. Maintenance task analysis data have been grouped in tables by helicopter model and aircraft subsystem. Supporting data have been assembled into appendixes.

ANALYSIS METHODOLOGY

FIELD DATA PROCESSING

The initial study task involved processing historical maintenance data for the helicopter systems and components scheduled for analysis. Two sources of data were used. Marine Corps 3-M data, acquired earlier under Contract DAAJ02-71-C-0047, was used for analysis of the UH-1 and AH-1 helicopters. Navy data on the TH-57A helicopter, included in the same file, was used for analysis of the Army OH-58 helicopter. Data for the OH-6, CH-47 and CH-54 helicopters was obtained from the Army TAMMS.

Marine Corps and Navy Data

Under Contract DAAJ02-71-C-0047, the Navy's Maintenance Support Office at Mechanicsburg, Pennsylvania supplied, via the Eustis Directorate, eight reels of magnetic tape containing 3-M system maintenance, flight and readiness activity for the H-1, H-46, H-53 and H-57 series helicopters. The data covered a two-year period ending June 1971 and included the following 3-M record types:

1. Type 11 Maintenance Transaction
2. Type 21 Maintenance Transaction
3. Type 31 Maintenance Transaction
4. Type 71 Readiness Transaction
5. Type 76 Flight Transaction

Data files were created for the Marine Corps UH-1 and AH-1 model helicopters and the Navy TH-57 helicopter. Table I shows the selected data base by record type and helicopter model.

TABLE I. H-1 AND H-57 HELICOPTER DATA BASE

Model	Record Type 11	Record Type 21	Record Type 31	Record Type 71	Record Type 76
UH-1E	50,373	15,602	16,595	41,520	33,894
AH-1G	15,457	3,437	4,384	10,879	10,580
AH-1J	1,958	360	250	2,174	1,255
TH-57A	16,909	742	56	9,780	22,703

A computer program using routines from Kaman's existing 3-M data processing system was developed to extract, format and process the data. The initial operation involved creation of separate tape files for each of the two basic helicopter models:

File 1. UH-1E, AH-1G, AH-1J

File 2. TH-57A

Simultaneously, the format of the input records was altered to condense the files and to speed sorting and processing efficiency. Figure 1 shows the format of the 80-character, 3-M records as received in the original tape files. Figure 2 shows the revised 45-character format produced as a result of the initial file extract runs. The program permits the creation of from one to five output files from any number of input files. Any combination of helicopter model types can be placed on each output file for a defined input time period.

Each model type file was sorted on record positions 5 through 15, yielding a file sequence as follows:

1. Flight Records (Type 76) by Aircraft Serial Number
2. Maintenance and Readiness Records (Types 11, 21, 31 and 71) by Work Unit Code (maintenance records in malfunction code sequence).

The sorted file was then fed to a tape-to-print run which produced three printed reports:

1. Flight Data by Aircraft Serial Number
2. R&M Statistical Summary
3. Record Count by Organization

Another program option provided a tabulation of flight hours by aircraft serial number and month as required to estimate the average monthly flight utilization for the various models.

The R&M Statistical Summary, a sample page is shown in Figure 3, provided the summary-level historical data input to the study. The report is in Work Unit Code sequence. Because code-to-nomenclature files were not

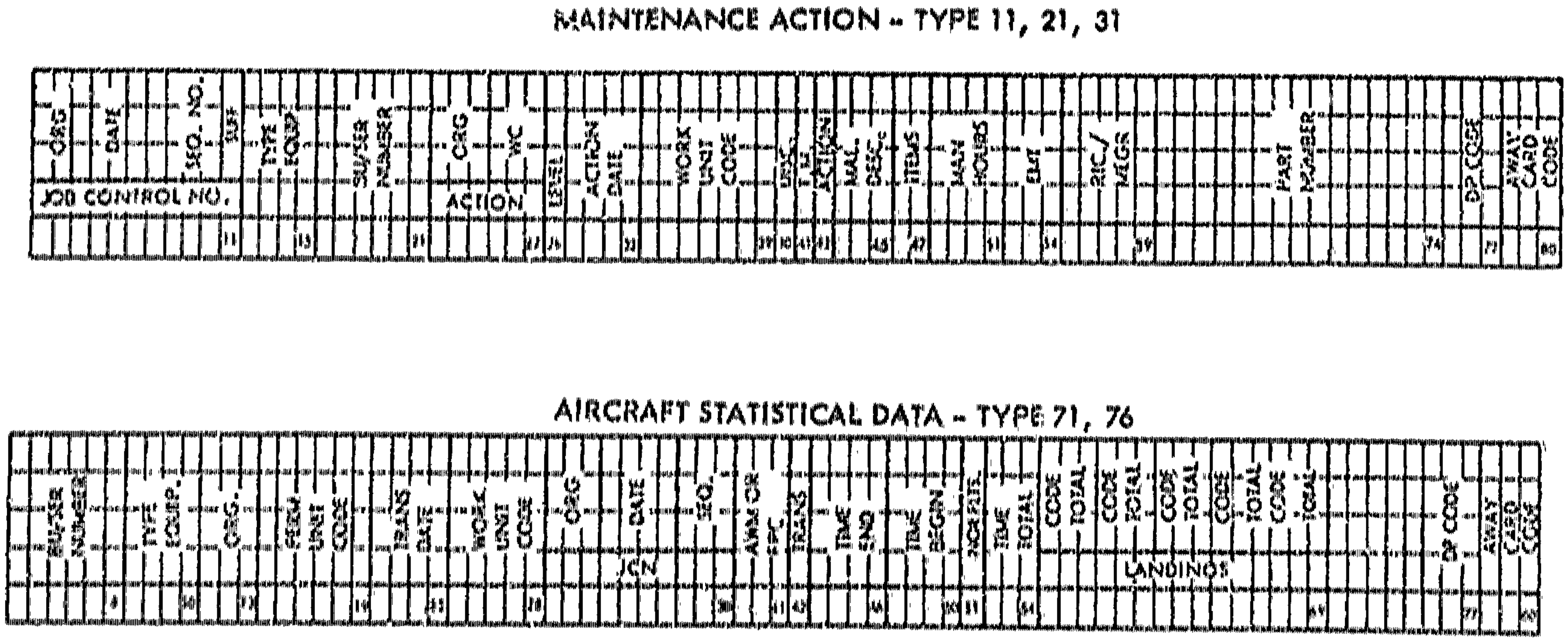


Figure 1. Navy 3-M Record Formats.

NOR RECORD (TYPE 71)

TYPE EQUIP. CODE	2	WORK UNIT CODE		TRANS CODE		AWM HOURS	NOR HOURS	ORG CODE	DATE	RECORD CODE
4	5	10		17		32	36	37	43	45

MAINTENANCE RECORD (TYPE 11, 21, 31)

TYPE EQUIP. CODE	2	WORK UNIT CODE	MALFUNCTION CODE		LEVEL	DISC CODE	TM CODE	ACTION CODE		ITEMS PROCESSED	ELAPSED MAINTENANCE TIME	MAN-HOURS	ORG CODE	DATE	RECORD CODE
4	5	12	15		17	18	19	20		29	32	36	39	43	45

FLIGHT RECORD (TYPE 76)

TYPE EQUIP. CODE	1	AIRCRAFT SERIAL NUMBER		TRANS CODE	LANDINGS										NO. FLTS.	HOURS	ORG CODE	DATE	RECORD CODE
					CODE	TOTAL	CODE	TOTAL	CODE	TOTAL	CODE	TOTAL	CODE	TOTAL					
4	5	11		17	18	20	21	23	24	26	27	29	30	32	33	36	39	43	45

Figure 2. Reformatted 3-M Records.

PERIOD - JULY 1969 THRU JUNE 1971 R AND M STATISTICAL SUMMARY REPORT 3405T (3/10/73) PAGE 16
MODELS UH-1E
FLIGHTS = 33494 FLT-HOURS = 61638 LANDINGS = 229779 RATES ARE PER 10,000 FLT-HOURS

WUC/ NOMENCLATURE	MTBF/ MTBR	FAIL/ REPL RATE	ORG/ INT MTBM	ORG/ INT MTTR	ORG/ INT MH/MA	ORG/ INT MH/FH	NORM/ NUMS NAVL	1ST MODE/ PCNT	2ND MODE/ PCNT	3RD MODE/ PCNT	4TH MODE/ PCNT	WHEN DISCOVERED DIST (PC) GP 1 / GP 5	GP 2 / GP 6	GP 3 / GP 7	GP 4 / GP 8	PRCNT FARCR CAUSE	PRCNT ENVMT CAUSE
13118																	
1311C			61838 8834	1.3	1.3												
1311D			61838	.9	.9												
1311F	1095 4757	9 2	982	1.2	2.1	21	3 1	381 49.1	070 14.0	127 9.8	070 7.0	9.3 29.1	7.0 3.5	12.3 28.1	15.8	9.3	
1311G	15460	1	15460	.6	1.0	1	4	433 25.0	341 25.0	525 25.0	691 25.0	 25.0		25.0	50.0		25.0
1311H	61838		61838 61838	1.0 99.5	1.0 100.0	81		710 100.0				 100.0					
13115	61838		61858	1.5	1.5			620 100.0				 100.0				100.0	
1311520	61638		61838	1.0	1.0			660 100.0						 100.0		100.0	
13115XX COMPONENT TOTAL	30919		30919	1.3	1.3							 50.0		 50.0		100.0	
13110	1432 8834	5 1	1819	5.8	20.3	112	14 3	780 31.3	730 29.0	070 12.5	105 12.5	3.1 21.9	6.3 9.4	9.4 21.9	28.1		
13111	515 6184	19 2	434 30919	1.6 .5	2.8 1.0	63	29 29	733 20.8	105 15.0	020 12.5	190 9.3	 35.8	.8 30.0	9.2 7.5	18.7	1.7	.8
1311130	61638		61838	9.0	9.0	1		104 100.0						 100.0			
13111XX COMPONENT TOTAL	511 6184	20 2	435 30919	1.7 .5	2.8 1.0	64	29 29					 35.5	.8 29.8	9.1 8.3	16.5	1.7	.9
13112	1405 10306	7 1	1262 61838	4.1 30.0	7.5 60.0	59 10	29 1	105 47.3	020 25.0	730 14.2	070 9.1	 2.3	 45.5	13.6 22.7	15.9	.	
13113	1213 4123	8 2	1104	1.4	2.0	18	2	020 47.1	193 13.7	106 11.9	105 7.8	9.9 25.5	 35.3	7.8 15.7	9.8	2.0	
13114	5622	2	7730	.4	.9	1		104 54.5	117 36.4	020 9.1		 27.3	 36.4	36.4			
13115	30919		30919 61838	2.9	4.5	1		073 50.0	105 50.0					50.0 50.0			

Figure 3. R and M Statistical Summary.

provided with the data supplied by the Navy, the report does not include the item nomenclature. There is a two-line printout of data for each work code reported.

Total lines are supplied at the component level (for items with a 6th and 7th digit WUC breakout) and at the subsystem, system and all-systems levels. An explanation of the data elements follows:

MTBF - The Mean-Time-Between-Failures for the work unit code. This value is computed by dividing total flight-hours for the model by the number of failures reported (scheduled actions, no-defect actions, cannibalization, etc., having been screened out).

MTBR - The Mean-Time-Between-Replacement (for failure) for the work unit code, obtained by dividing flight-hours by the number of reported replacements due to failure.

FAIL RATE - The rate of failure per 10,000 flight-hours.

REPL RATE - The rate of replacements for failure per 10,000 flight-hours.

ORG MTBM - The Mean-Time-Between-Maintenance at the organizational level, obtained by dividing flight-hours by the total number of maintenance actions reported at Level 1. (organizational level)

INT MTBM - The Mean-Time-Between-Maintenance at the intermediate level, obtained by dividing flight-hours by the total number of maintenance actions at Level 2. (Intermediate level)

ORG MTTR - The Mean-Time-To-Repair at the organizational maintenance level, obtained by dividing the total reported elapsed maintenance time at Level 1 by the number of actions reported.

INT MTTR - The Mean-Time-To-Repair at the intermediate maintenance level, obtained by dividing the total reported elapsed maintenance time at Level 2 by the number of actions reported.

ORG MH/MA - The average man-hours per maintenance action at the organizational level, obtained by dividing the total reported man-hours at Level 1 by the number of maintenance actions reported.

ORG MH/FH - The maintenance man-hours per 10,000 flight-hours at the organizational level, obtained by dividing Level 1 man-hours x 10^4 by flight-hours.

INT MH/FH - The maintenance man-hours per 10,000 flight-hours at the intermediate level, obtained by dividing Level 2 man-hours x 10^4 by flight-hours.

NORM RATE - The number of hours per 10,000 flight-hours the work unit code component caused the aircraft to be not operationally ready for maintenance.

NORS RATE - The number of hours per 10,000 flight-hours the work unit code component caused the aircraft to be not operationally ready for supply.

FOUR-HIGH FAILURE MODES - The 3-M malfunction codes for the four-high failure modes reported and their percent contribution to total failures (in descending order).

WHEN DISCOVERED DISTRIBUTION - The percent distribution of failures by "when discovered" category within eight groups:

Group 1 - Preflight (Abort)

Group 2 - Inflight (Abort)

Group 3 - Before Flight/Preflight Inspection

Group 4 - Between Flights/Postflight or Daily Inspection

Group 5 - Inflight (No Abort)/ Test Flight

Group 6 - Calendar Inspection

Group 7 - Other Inspection

Group 8 - All Other

PRCNT ERROR CAUSE - The percent of total failures caused by maintenance or operator error.

PRCNT ENVMT CAUSE - The percent of total failures caused by weather or environmental factors.

The R&M Statistical Summaries were used to provide the principal statistical input to the data analysis task. From this report, the analyst selected, by work unit code, the components for which more detailed maintenance data was needed.

Figure 4 shows the overall data processing flow used for the study. Operations shown enclosed in the dash-lined area are those completed under Contract DAAJ02-71-C-0047. The additional data processing requirements shown were completed under the present study.

One of the two additional reports produced from the Marine Corps and Navy data was also used extensively in the study. This report, Maintenance Summary by Malfunction and Disposition, Report 3M004, is shown in Figure 5. The report arrays reported maintenance actions by malfunction code and type of action taken in a matrix-type display. The total man-hours and elapsed maintenance time are printed for each malfunction category. The average man-hours per maintenance action is also printed. Totals are printed for line maintenance, shop maintenance and the sum of both levels for the work unit code. This report was used to establish the types of maintenance being expended on the component, the relative frequency of each type, and the average man-hours involved.

The second report produced under the study is the Detailed Maintenance Action List, Report 3M030, shown in Figure 6. Each line of the report represents a separate maintenance transaction. Report content is specified with a series of input parameter cards which identify the criteria for inclusion or exclusion of a transaction from the report. For example, the analyst could request a report containing failure-type actions only. Among the items of information contained in the report are type of maintenance, maintenance level, when discovered code, malfunction code, quantity, man-hours, and elapsed maintenance time. This report was used by the analyst during the task classification and analysis procedure. It was also used in cases where summarized data was thought to be inaccurate or incomplete to determine the nature of suspected errors and omissions.

The three reports described above were produced for the UH-1E, AH-1G/J and TH-57A helicopters.

The generic component types specified by the Army were translated into work unit codes for the UH-1E, AH-1G/J and TH-57A helicopters. These codes were later used to

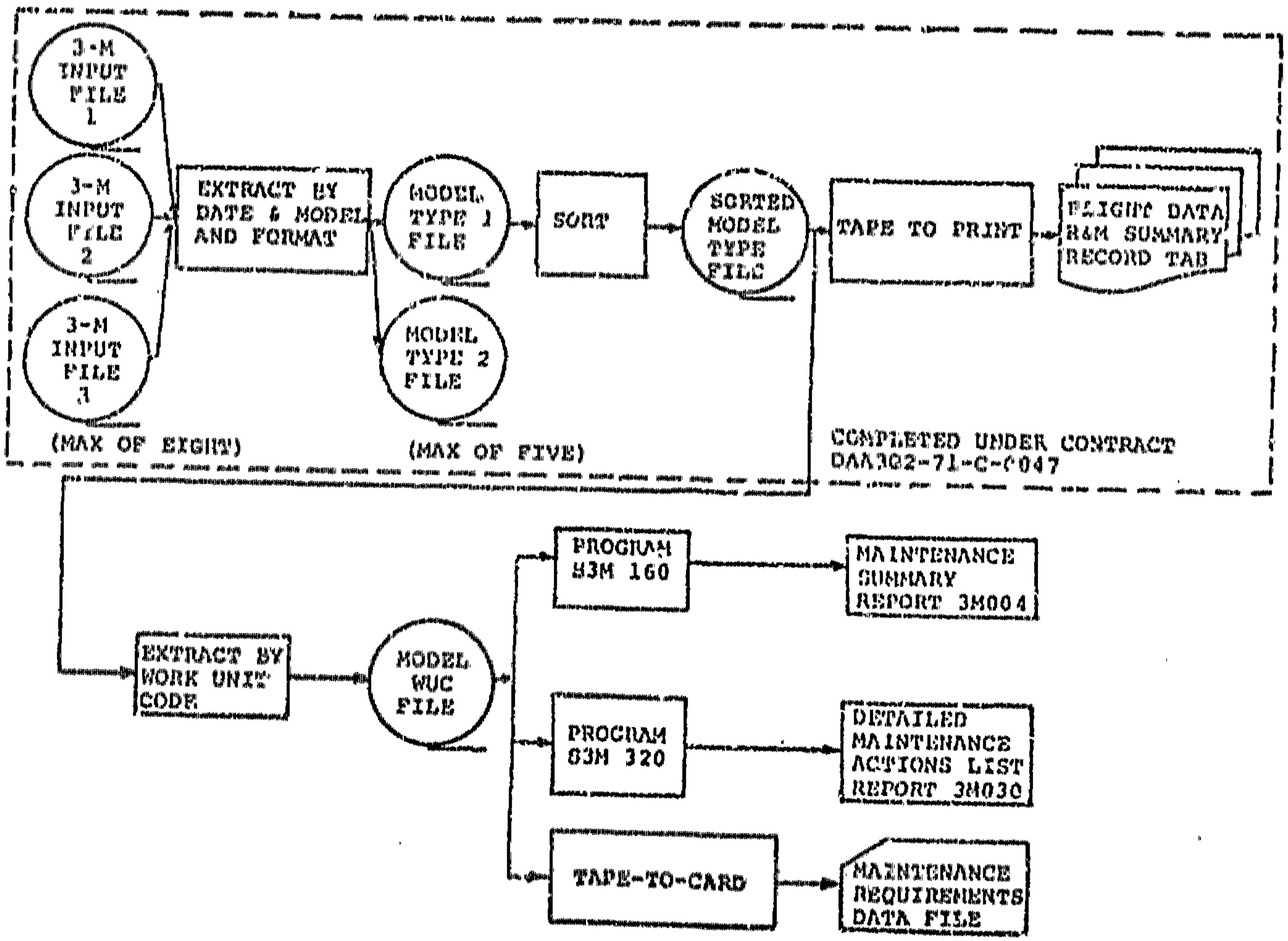


Figure 4. Data Processing Flow.

JULY 1969 THRU JUNE 1971 FLT-HOURS = 61836 MAINTENANCE SUMMARY BY MALFUNCTION AND DISPOSITION REPORT 3M996 PAGE 6
MODELS UH-1E

RPR = REPAIR RPL = REMOVE/REPLACE RIN = REMOVE/REINSTALL RFM = REMOVED INS = INSTALLED
CAL = CALIBRATE TBL = TROUBLESHOOT COR = TREAT CORROSION CHK = CHK/NO DEFECT CRN = CANNIBALIZE/REMOVE
CRP = CANNIBALIZE/REPL RCM = BEYOND CAPABILITY OTH = OTHER * NOT COUNTED AS FAILURE + FAILURE BASED ON HOW MAL

COD	MAL DESCRIPTION	MAINT ACTNS	TOTAL ITEMS	FAIL-URES	RPR	RPL	RIN	REM	INS*	CAL	TBL*	COR*	CHK*	CRN*	CRP*	RCM	OTH	MAN HOURS	ELAP TIME	MHRS/ ACTN
170	CORRODED	1	1									1						1.0	1.0	1.0
190	CRACKED	19	20	20	16	4												186.0	84.5	9.8
230	DIRTY	1	1	1	1													.3	.3	.3
246	IMPROP/FAULTY MAINT	1	1	1	1													.6	.3	.6
425	NICKED	1	1	1		1												13.0	6.5	13.0
540	PUNCTURED																	8.0	8.0	
730	LOOSE	1	1	1	1													.5	.5	.5
*799	NO DEFECT	1	1						1									17.0	9.6	17.0
*800	NO-DEF/OTHER MAINT	1	1				1											6.0	3.0	6.0
878	WEATHER DAMAGE	1	2	2	2													.5	.5	.5
	ORG TOT	58	59	57	45	14	1		1			1						636.1	278.3	11.0
	HUC TOT	58	60	57	45	14	1		1			1						636.1	278.3	11.0
11110		** ORG ACTIONS **																		
020	WORN,CHAFED,FRAYED	6	6	6	6													10.9	10.9	1.8
070	BROKEN	3	3	3	2	1												42.1	23.3	14.1
115	LOOSE/DAMAG HARDWARE	5	5	5	4													9.1	9.1	1.0
136	MISSING HARDWARE	9	10	6	6	1			1									23.3	13.3	2.6
117	DETERIORATED	3	3	3	1													24.5	13.0	8.2
170	CORRODED	7	7	2	2							2						39.4	12.7	5.7
190	CRACKED	104	106	106	105							5						301.3	304.5	3.4
194	UNIDENTIFIED BY CODE	1	1	1	1													1.5	1.5	1.5
230	DIRTY	2	2	2	2													.5	.5	.3
396	OIL BREATHING EXCESS	1	1	1	1													.5	.5	.5
425	NICKED	1	1	1	1													.5	.5	.5
520	PITTED	1	1	1	1													.3	.3	.3
540	PUNCTURED	18	18	18	18													92.4	40.7	2.9
640	STRIPPED	2	3	2	2													.8	.8	.4
730	LOOSE	7	7	7	7													12.5	10.5	1.8
731	RAISED DAMAGE	8	17	17	16			1										158.5	92.5	24.5
780	BENT,BUCKLED,ETC	13	13	13	13													84.2	90.7	6.5
*799	NO DEFECT	2	2						1				1					2.3	2.3	1.2
*800	NO-DEF/OTHER MAINT	3																29.0	12.0	9.3
846	DELAMINATED	1	1	1	1													1.5	1.5	1.5
479	UNIDENTIFIED BY CODE	1	1	1	1													1.0	1.0	1.0
935	SCORED OR SCRATCHED	1	1	1	1													.7	.7	.7
947	TORN	4	5	5	5													13.1	9.2	3.3
	ORG TOT	203	213	205	200	2		1	2			7	1					935.6	617.9	4.6
		** IMA ACTIONS **																		
190	CRACKED	1	1		1													18.3	9.0	18.0
	IMA TOT	1	1		1													18.3	9.0	18.0
	HUC TOT	204	214	205	201	2		1	2			7	1					953.6	326.5	4.7
11113		** ORG ACTIONS **																		
070	BROKEN	1	1	1		1												1.0	.5	1.0
106	MISSING HARDWARE	2	2	1	1				1									1.0	1.0	.5
170	CORRODED	1	2									2						5.4	2.8	5.8
190	CRACKED	16	16	16	16													44.8	36.8	2.8

Figure 5. Maintenance Summary by Malfunction and Disposition.

DATE 07/20/72 DETAILED MAINTENANCE ACTIONS LIST REPORT 3M030 PAGE 45
PERIOD 07/69 THRU 06/71 MODELS UH-1E

WUC	NOMENCLATURE	MODEL CODE	BUNO	DATE	LEV	TM	WHEN DISC	ACTN TAKN	MAL CODE	QTY	MAN HOURS	ELPSD TIME	TOT ACT	TOT M/H	TOT ENT	ORG	ACRO
14118		UH-1E		10/03/69	1	Q	N	C	660	1	1.0	1.0				FCA	11
14118		UH-1E		09/03/69	1	B	N	C	660	1	.5	.5				FCA	11
													2	1.5	1.5		
14118		UH-1E		02/04/71	1	B	K	C	710	1	1.0	1.0				GHC	11
14118		UH-1E		02/03/71	1	P	N	C	710	2	1.0	1.0				GHC	11
													2	2.0	2.0		
14118		UH-1E		12/31/70	1	P	N	N	710		1.0	1.0				GHC	11
14118		UH-1E		01/31/71	1	P	N	N	710		1.0	1.0				GHC	11
14118		UH-1E		12/31/70	1	Q	N	N	710		1.3	1.3				GHC	11
14118		UH-1E		12/31/70	1	W	N	N	710		.3	.3				GHC	11
														3.6	3.6		
14118		UH-1E		02/16/70	1	B	O	R	710	1	2.0	2.0				GHC	11
14118		UH-1E		02/17/70	1	V	N	R	710	2	3.0	3.0				GCA	11
14118		UH-1E		03/17/70	1	Q	N	R	710	1	1.0	1.0				FCA	11
14118		UH-1E		10/16/69	1	D	-	R	710	1	1.0	.5				GKB	11
													4	7.0	6.5		
14118		UH-1E		02/10/70	1	W	O	R	720	1	2.0	1.0				FCA	11
14118		UH-1E		02/10/70	1	B	A	R	720	1	4.0	2.0				FCA	21
													2	6.0	3.0		
14118		UH-1E		08/15/70	1	B	K	D	730	1	1.0	1.0				GHC	11
													1	1.0	1.0		
14118		UH-1E		10/13/70	1	B	P	C	730	1	1.0	1.0				GHC	11
14118		UH-1E		01/19/70	1	B	D	C	730	1	.5	.5				FCA	11
14118		UH-1E		04/23/71	1	W	K	C	730	1	2.1	.7				GKB	11
14118		UH-1E		11/14/70	1	B	P	C	730	1	7.0	7.0				GHC	11
14118		UH-1E		08/26/70	1	A	K	C	730	1	2.0	2.0				GHC	11
14118		UH-1E		08/05/69	1	B	K	C	730	1	2.0	1.0				GKB	11
14118		UH-1E		03/18/70	1	B	N	C	730	1	1.0	1.0				GCA	11
14118		UH-1E		07/03/69	1	B	H	C	730	2	4.0	2.0				W22	11
14118		UH-1E		11/21/70	1	B	K	C	730	1	1.0	1.0				GHC	11
14118		UH-1E		07/15/69	1	U	P	C	730	1	9.0	4.5				FCA	11
14118		UH-1E		02/07/71	1	B	J	C	730	1	1.0	1.0				GHC	11
14118		UH-1E		01/12/71	1	B	C	C	730	1	1.0	1.0				GHC	11
													12	31.4	22.7		
14118		UH-1E		01/07/71	1	B	O	A	799	1	.5	.5				GHC	11
14118		UH-1E		01/19/70	1	W	A	A	799	1	.5	.5				FCA	11
14118		UH-1E		01/13/71	1	W	8	A	799		.5	.5				GHC	11
													3	1.5	1.5		
14118		UH-1E		12/23/70	1	B	O	T	799	1	1.0	1.0				GHC	11
14118		UH-1E		12/16/70	1	B	U	T	799	1	5.1	5.3				GKB	11
14118		UH-1E		10/21/70	1	W	O	T	799	1	.5	.5				GKB	11
14118		UH-1E		10/03/69	1	A	O	T	799	1	1.0	5.0				FCA	11
14118		UH-1E		08/26/70	1	W	O	T	799	1	.5	.5				FCA	11
14118		UH-1E		02/10/71	1	A	O	T	799	2	8.6	4.3				GKB	11
14118		UH-1E		02/10/71	1	W	O	T	799	2	8.6	4.3				GKB	11
14118		UH-1E		12/23/70	1	B	O	T	799	1	1.0	1.0				GHC	11
14118		UH-1E		03/27/71	1	B	O	T	799	1	1.0	1.0				GHC	11
14118		UH-1E		11/26/69	1	O	U	T	799	1	1.0	1.0				GKB	11
14118		UH-1E		12/04/69	1	B	O	T	799	1	1.0	1.0				GKB	11
14118		UH-1E		09/22/69	1	W	O	T	799	1	1.5	1.5				GHC	11
14118		UH-1E		06/25/69	1	W	O	T	799	1	2.0	1.0				FCA	11
													13	33.0	23.4		
14118		UH-1E		01/03/71	1	B	8	W	799	1	.6	.8				GHC	11
14118		UH-1E		09/22/69	1	B	S	W	799	1	1.5	1.5				GHC	11
14118		UH-1E		12/09/69	1	B	8	W	799	1	2.0	2.0				GKB	11

Figure 6. Detailed Maintenance Actions List.

extract specific components from the computer-processed data for use in the maintenance requirements analysis. For each of the generic component types, work unit codes were extracted from the respective 3-M Work Unit Code Manual, covering the end assembly and each of its significant subassemblies (where pertinent). These codes were then arranged to show logical groupings of components where the sequence of codes in the manual did not provide this. Table II shows an initial listing of typical work unit codes for the AH-1G prior to the statistical screening which took place later.

TABLE II. TYPICAL WORK UNIT CODE EXTRACTION, AH-1G HELICOPTER

Work Unit Code	Component Nomenclature
26111	Main Drive Shaft Assembly
26211	Main Transmission Assembly
26212	Plate Assembly
26213	Breather Vent
26214	Manifold
26215	Coupling
2621C	Mast Assembly
2621E	Main Input Quill
26244	Oil Pressure Relief Valve
26246	Oil Pressure Switch
26411	Tail Drive Shaft Assembly
26412	Clamp
26413	Hanger Assembly
26414	Intermediate Gearbox
26415	Tail Gearbox

From the tape data files generated for each of the three helicopter model-types, punched card files were produced to cover those components selected for further analysis (Figure 4). The criteria for inclusion of components in the file is described in the following section on Army TAMMS Data. The file format is shown in Figure 9.

Army TAMMS Data

Data for analysis of maintenance requirements on the OH-6, CH-47 and CH-54 helicopters was supplied by AAMRDL. It consisted of Army TAMMS data processed by the Northrop Corporation and published in hard-copy printouts. The data processing and editing operations performed by Northrop are explained in their report on the CH-47 helicopter. (1)

The TAMMS data is arranged in volumes by helicopter model, one volume each for the OH-6A, CH-47A and CH-54A. Each volume is prefaced by several indexes which rank components on the basis of maintenance rate, man-hours, and job average. The index was screened to match specific components on each helicopter model to the generic component list. This resulted in a list of specific components, identified by part number and/or stock number, for which maintenance data was to be extracted from the detailed data sheets.

Figure 7 is a sample page from the TAMMS data printout, showing those portions of the data used for the analysis. The report referenced above explains the methodology used by Northrop to classify data into the action categories shown. The categories denoted by the numbers 1 thru 13 in the left margin of the table are those which were selected for the maintenance requirements analysis.

Specific actions were eliminated if the action rate per 10,000 hours was less than 5% of the rate for the component total. The malfunctions for each action were also eliminated if the malfunction comprised less than 5% of the total for that action. This was done to reduce the amount of data to be processed without significantly affecting the results.

(1) Bado, J. A., MacCarley, J. A. et.al., MAINTENANCE DATA TABULATIONS, CH-47A, Northrop Corporation, Report WSDS 72-5, July 1972. Contract DAAJ02-71-D-0002.

OH-6A
MANHOURS PER 1000 FLT HOURS
1970 DATA
(ORG, DS, AND GS)

5140930913D
BATTERY

ACTION	RATE/1000	INDEX	AVG
1 REMOVE/REPLACE(A)	0.8366	1.5460	1.8
2 REMOVE/REINSTALL(L)	0.5094	0.9229	1.8
3 REMOVE (R)	0.0349	0.0192	0.5
4 INSTALLED (S)	0.0087	0.0087	1.0
5 TESTED (J)	0.1220	0.0959	0.8
6 CHECKED,SERVICE(F)	0.0959	0.3965	4.1
7 CHECKED, NRTS (H)	*		
8 CHECKED,NOT REP.(N)	*		
9 SERVICEABLE (A)	*		
NRTS-NOT AUTHRZD(1)	*		
NRTS-LACK EQUIP (2)	*		
NRTS-LACK SKILLS(3)	*		
NRTS-LACK OF PART(4)	*		
NRTS-BACKLOG (5)	*		
NRTS-LACK OF DATA(6)	*		
NRTS-EXCND (7)	*		
[illegible] (8)	*		
[illegible] CONDEMNED(9)	*		
[illegible] (X)	*		
10 ADJUSTED (B)	0.0174	0.0218	1.3
11 REPAIRED (C)	0.1133	0.4270	3.8
12 REPAIRED (D)	*		
13 REBUILT (D)	*		
COMPONENT TOTAL	1.0240	3.8604	1.9

MALFUNCTIONS-PERCENT X 10^{-2}

MISSING	0.043	SHORTED	0.057
IMPROPERLY-INSTALLED	0.014	INCORRECT VOLTAGE	0.057
BROKEN	0.100	COLLAPSED	0.014
WORN EXCESSIVELY	0.029	BURNED OUT	0.029
NO DEFECT FACLTS MAIN	0.014	NOT LISTED	0.029
OVERHEATD	0.014	LEAKING	0.029
DRY	0.014	NOT LISTED	0.029
BUCKLED	0.014	NOT LISTED	0.014
CRACKED	0.029	IMPROPR SOURCE OUTPU	0.014
DIRTY	0.014	OUTPUT TOO LOW	0.014
CORRODED	0.014		
BURNED	0.061	NO DEFECT-RMVD SCHED	0.333
CURRENT INCORRECT	0.030	NO DEFECT	0.152
BROKEN	0.061	NO DEFCT FACLTS MAIN	0.121
OUTPUT TOO LOW	0.030	BURNED OUT	0.030
CRACKED	0.030		
SHORTED	0.250	NOT LISTED	0.250
NO DEFECT	0.250		
CANNIBALIZATION	1.000		
NOT LISTED	0.500	INCORRECT VOLTAGE	0.500
BROKEN	0.231	BURNED OUT	0.077
OVERHEAT	0.077	NOT LISTED	0.077
CORRODED	0.231	CRACKED	0.077

Figure 7. TAMMS Data Printout

The logging of malfunction data onto punched cards was accomplished in the following manner. The thirteen actions to be considered were assigned an action number (column 9) and a segment number (column 14) Figure 8. Column 10 was used to indicate whether the maintenance was performed on (=1) or off (=2) the aircraft. The malfunction code (columns 11 thru 13) was derived from the Navy's standard malfunction code set (3-M) by matching the narrative description of the malfunction given in the Northrop reports. Examples of the three-digit malfunction codes used are:

Malfunction Code	Malfunction
070	Broken
615	Shorted
169	Incorrect Voltage
374	Internal Failure
900	Burned
799	No Defect
800	No Defect - Removed to Facilitate Other Maintenance
804	No Defect - Removed for Scheduled Maintenance

The procedure for filling out columns 15 and subsequent of the data cards is discussed next with reference to Figures 7 and 9.

The last row of Figure 7 contains the action rate and maintenance rate (index) totals for the component. These two values (x 1000) are entered in card fields 9 and 10 respectively, of Figure 9. The component nomenclature is entered in field 11.

In the second row of Figure 9, field 5, the action code corresponding to "Remove/Replace (A)" - code 6 - has been entered. It is followed by the action rate (837) and man-hours index (1546) for that action.

	ACTION	9 ACTION	10 ON/OFF	11 MAL CODE	12	13	14 SEGMENT
1.	REMOVE/REPLACE (A)	6	1				1
2.	REMOVE/REINSTALL (L)	6	1				2
3.	REMOVE (R)	4	1				0
4.	INSTALLED (S)	5	1				0
5.	TESTED (J)	1	1				0
6.	CHECKED, SERVICE (P)	1	1				0
7.	CHECKED, NRTS (M)	8	2				0
8.	CHECKED, NOT REP. (N)	8	2				0
9.	SERVICEABLE (A)	1	2				0
10.	ADJUSTED (B)	2	1				0
11.	REPAIRED (C)	3	1				0
12.	REPAIRED (B)	3	2				0
13.	REBUILT (D)	7	2				0
	COMPONENT TOTAL	0	0	0	0	0	0

Figure 8. TAMMS Data Extraction Code System.

The next five card entries represent the malfunction codes contributing at least 5% to the action rate for the maintenance action. The values in field 9 for these cards are percent (x 10) of the action rate (837) entered in field 9 of the action summary card.

The above procedure was carried out for all of the components selected for analysis on the OH-6A, CH-47A and CH-54A helicopters. This produced three punched-card files, to be combined with those generated by computer for the other three model-types, for use as input to the maintenance requirements analysis.

The TAMMS data, as received, was organized by component part number and/or stock number. In order to provide for a data display, compatible with that used for the Marine Corps data, work unit codes had to be assigned to the components selected for each of the three helicopter models: OH-6A, CH-47A and CH-54A. Codes were developed for each component using the appropriate system code from the Navy's 3-M work unit code structure followed by the number representing the sequence of that component in the man-hour index from the Northrop report.

A gearbox on the CH-47A would, for example, have been assigned system code 26 (Drives). If that gearbox appeared as the 28th item in the man-hour sequenced index in the CH-47A data volume, the complete work unit code assignment would have been - 26028. This system related components to a common system arrangement for both sets of data. Using the index sequence number to complete the work unit code also provided a ready cross-reference to the Northrop reports. The work unit codes thus generated were entered in field 3 of the punched card sets as shown in Figure 9.

1	2	3					4	5	6	7			8	9				10				11						
FILE	MODEL	END ASSEMBLY WUC					CARD	ACTION	ON/OFF	MAL CODE			SEGMENT	RATE/ ACTION				MAN-HOUR INDEX				NOMENCLATURE						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24					
1	4	4	2	8	7	2	2	0	0	0	0	0	0	3	0	2	4	5	8	6	1	B	A	T	T	E	R	Y
1	4	4	2	8	7	2	2	6	1	0	0	0	1		8	3	7	1	5	4	6							
1	4	4	2	8	7	2	2	6	1	0	7	0	1		1	0	0											
1	4	4	2	8	7	2	2	6	1	6	1	5	1			5	7											
1	4	4	2	8	7	2	2	6	1	1	6	9	1			5	7											
1	4	4	2	8	7	2	2	6	1	3	7	4	1			8	6											
1	4	4	2	8	7	2	2	6	1	9	0	0	1		1	5	7											
1	4	4	2	8	7	2	2	6	1	0	0	0	2		5	0	5		9	2	3							
1	4	4	2	8	7	2	2	6	1	9	0	0	2			6	1											
1	4	4	2	8	7	2	2	6	1	0	7	0	2			6	1											
1	4	4	2	8	7	2	2	6	1	8	0	4	2		3	3	3											
1	4	4	2	8	7	2	2	6	1	7	9	9	2		1	5	2											

Figure 9. Punched Card Format, Maintenance Requirements Data File.

MAINTENANCE REQUIREMENTS ANALYSIS

One requirement of this study was to identify the failure modes and maintenance requirements which generate the high man-hour consuming tasks on each of the six helicopter models. The data processing tasks just described provided maintenance data for each of the aircraft upon which an analysis of maintenance requirements was based.

The purpose of the maintenance requirements analysis was to identify the significant man-hour consumers among the list of generic components being analyzed and to isolate the actions and failure modes which contribute most heavily to the maintenance burden on each component. The maintenance data on each aircraft was screened to eliminate from further study components which historically did not represent a significant share of the maintenance burden on that aircraft. The general guideline used was to drop components which did not contribute at least .5% to the overall man-hour per flight-hour rate. This was not rigidly adhered to in every case, however. Certain components which revealed a high overall job average or an excessive action rate were retained despite having failed to meet the general cutoff criteria on man-hours. In other cases, components which exceeded the cut-off criteria were dropped because of extenuating factors - an excessively high cannibalization rate for example.

After the component screening was completed, data on each component was analyzed to extract the high man-hour contributors by type of action and cause. Maintenance records were grouped into one of the following action-type categories:

1 - Check

2 - Adjust

3 - Repair

4 - Remove

5 - Install

6 - Replace

7 - Rebuild

8 - NRTS (Not Repairable This Station)

Action categories which did not contribute at least 5% to the man-hour rate for the component were dropped. Next, causes within each action category were examined by malfunction type code. Failure modes or reasons for maintenance which contributed less than 2.5% to the action rate for the component were also dropped. (Action rate rather than man-hour rate was used as the criterion because the TAMMS data as formatted did not show the contribution to man-hours by cause). The result of this procedure was to distill the overall maintenance history on each component down to those actions which contributed at least 5% of the component man-hour rate and those causes within actions which contributed at least 2.5% of the component action rate.

The data thus assembled was prepared in punched-card format to facilitate formatting and calculation of required statistics. The format of the card records was shown earlier in the section on TAMMS data processing. The file code structure included codes for the helicopter model, type maintenance action (listed earlier), where performed designation, malfunction or reason for maintenance, and the maintenance level. The model codes used were:

1 - UH-1

2 - AH-1

3 - OH-58

4 - OH-6

5 - CH-47

6 - CH-54

The codes designating where the action was performed were:

1 - On-Aircraft

2 - Off-Aircraft

The malfunction or reason for maintenance codes were taken directly from the standard malfunction code set used in the Navy's 3-M Maintenance Data Collection System. The maintenance level codes used were:

1 - Organizational

2 - Direct Support

3 - General Support

A FORTRAN computer program was written to tabulate data from the six punched-card files. Figure 10 is a sample page from the computer printout. The table is arranged by components within the aircraft. Each component is identified by its work unit code and nomenclature.

Within each component, data is tabulated by maintenance action category and reason/failure mode. The following elements of data are printed for each maintenance action:

<u>ON/OFF/A/C</u> - where the maintenance action is performed on or off the aircraft.

<u>LEV</u> - the maintenance level at which the maintenance action is performed.

<u>MH/MA AVG</u> - the average man-hours per maintenance action

$$= \frac{\text{Total Man-Hours}}{\text{Total Maintenance Actions}}$$

<u>AVG NO MEN</u> - the average number of men required per maintenance action as derived from the historical maintenance data. (This statistic was available only for those aircraft for which Marine Corps and Navy data was used).

$$= \frac{\text{Total Man-Hours}}{\text{Total Elapsed Maintenance Time}}$$

<u>MA/FH RATE</u> - the maintenance frequency in terms of actions per 10,000 flight-hours.

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG MC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-M-K MA/ FH	 MH/ FH
15110 SCISSORS/SLEEVE ASSY										
REPAIR	ON	O	2.0	1.4	24.1	21.5	47.4	18.5	2	2
020 WORN,CHAFED,FRAYED				*	11.5	10.3	23.7	9.3		
127 ADJST/ALIGN IMPROPER				*	2.9	2.6	7.5	2.9		
REPLACE	ON	O	5.7	1.7	43.7	39.0	248.9	97.4	1	1
020 WORN,CHAFED,FRAYED				*	30.6	27.3	139.4	54.5		
710 BRG FAILING/FAULTY				*	3.5	3.2	11.2	4.4		
803 NO-DEF/TIME CHANGE				*	4.4	3.9	67.9	26.6		
OTHER			0.0		44.1	39.5	0.0	0.0		
COMPONENT TOTAL			2.6	1.6	111.9	100.0	296.2	100.0		
15115 MAIN ROTOR HUB ASSY										
REPAIR	OFF	O	17.8	2.0	14.4	14.9	256.1	30.7	2	2
020 WORN,CHAFED,FRAYED				*	3.2	3.4	83.5	10.0		
710 BRG FAILING/FAULTY				*	6.0	6.2	123.7	14.9		
REPLACE	ON	O	11.1	2.6	33.6	34.9	373.4	44.8	1	1
020 WORN,CHAFED,FRAYED				*	6.6	6.9	67.2	8.1		
190 CRACKED				*	4.4	4.5	52.6	6.3		
710 BRG FAILING/FAULTY				*	3.6	3.7	42.9	5.2		
803 NO-DEF/TIME CHANGE				*	3.7	3.9	30.8	4.7		
OTHER			4.2	2.0	48.3	50.2	203.5	24.4		
COMPONENT TOTAL			8.6	2.2	96.4	100.0	833.1	100.0		
15118 MAIN ROTOR CNT WT ASSY										
REPAIR	ON	O	2.0	1.5	3.6	62.9	7.2	72.5	1	1
020 WORN,CHAFED,FRAYED				*	0.5	8.6	0.5	4.9		
070 BROKEN				*	0.3	5.7	0.5	4.6		
127 ADJST/ALIGN IMPROPER				*	0.8	14.3	0.8	8.2		
135 BINDING/STUCK/JAMMED				*	0.3	5.7	0.2	1.7		
410 LACK OF/IMPROP LUBE				*	0.3	5.7	0.1	1.0		
REPLACE	ON	O	1.4	1.6	1.1	20.0	1.6	16.0	2	2
020 WORN,CHAFED,FRAYED				*	0.2	2.9	0.2	2.3		
070 BROKEN				*	0.8	14.3	0.9	9.0		
730 LOOSE				*	0.2	2.9	0.5	4.6		
OTHER			1.2	1.2	1.0	17.1	1.1	11.5		
COMPONENT TOTAL			1.7	1.5	5.7	100.0	9.9	100.0		

Figure 10. Maintenance Requirements Data Format.

$$= \frac{\text{Total Maintenance Actions} \times 10{,}000}{\text{Aircraft Flight Hours}}$$

MA/FH PCNT - the percentage contribution of this maintenance action to the total maintenance frequency for the component.

$$= \frac{\text{Total Actions (This Action)} \times 100}{\text{Total Actions (Component)}}$$

MH/FH RATE - the maintenance rate in terms of man-hours per 10,000 flight hours.

$$= \frac{\text{Total Man-Hours} \times 10{,}000}{\text{Aircraft Flight-Hours}}$$

MH/FH PCNT - the percentage contribution of this maintenance action to the total maintenance rate for the component.

$$= \frac{\text{Total Man-Hours (Action)} \times 100}{\text{Total Man-Hours (Component)}}$$

RANK MA/FH - the ranking of this action in terms of the overall component maintenance frequency (maintenance actions per 10,000 flight-hours).

RANK MH/FH - the ranking of this action in terms of overall component maintenance rate (maintenance man-hours per 10,000 flight-hours).

Following the summary line for the maintenance action is a breakout of the reasons for maintenance and failure modes for that action. The code and description are followed by the action rate and percent contribution to total actions for that reason/mode. For the three helicopter models using Marine Corps and Navy data (UH-1, AH-1 and OH-58), the man-hour rate and percent contribution to total man-hours are also printed.

In cases where certain maintenance actions have been screened out of the data for having failed to meet the cutoff criterion or where the data could not be properly categorized because of errors or omissions, the balance between the sum of the tabulated actions and the component totals is shown as "OTHER". This line immediately precedes the "COMPONENT TOTAL" line.

Tables III thru VIII contain the overall repair and component statistics for the six helicopter models developed from this analysis. Three additional tabulations for each of the six helicopter models, ranked by average man-hours per task, are contained in Appendixes I thru III. Appendixes I and II contain rankings of on-aircraft and off-aircraft repairs respectively. Appendix III contains a ranking of component replacement actions. The complete results of the maintenance requirements analysis for the six helicopters are contained in Appendix IV.

TABLE III. COMPONENT REPAIR AND REPLACEMENT STATISTICS, OH-58 HELICOPTER

Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
14123 Swashplate/Support Assembly	Replace	ON	D.S.	2,857	6.2	215
	Repair	ON	D.S.	613	3.4	545
14142 Cyclic Servo Actuator	Replace	ON	ORG.	800	2.5	312
	Repair	ON	ORG.	459	2.3	493
14144 Collective Servo Actuator	Replace	ON	ORG.	5,882	2.7	47
	Repair	ON	ORG.	1,818	1.3	71
15111 Main Rotor Hub	Replace	ON	D.S.	4,762	7.4	154
	Repair	ON	D.S.	336	7.6	2,259
15114 Hub Grip Reservoir	Replace	ON	ORG.	1,695	0.7	41
	Repair	ON	ORG.	81	1.5	1,819
15211 Tail Rotor Hub	Replace	ON	ORG.	2,631	5.4	206
	Repair	ON	D.S.	719	1.6	226
15215 Tail Rotor Blade	Replace	ON	D.S.	1,149	4.4	381
	Repair	ON	ORG.	990	1.8	185
22500 T-63 Engine	Replace	ON	D.S.	474	26.9	5,112
22561 Fuel Pump	Replace	ON	D.S.	926	2.8	301
	Repair	ON	ORG.	1,031	2.3	219
22562 Main Fuel Control	Replace	ON	D.S.	1,205	3.4	283
	Repair	ON	ORG.	412	1.7	410
22563 Governor	Replace	ON	D.S.	1,316	3.0	229
	Repair	ON	ORG.	926	2.0	213
22566 Fuel Check Valve	Replace	ON	D.S.	1,613	2.2	137
	Repair	ON	ORG.	2,381	1.0	43
22572 Lube Filter	Replace	ON	ORG.	4,762	1.2	25
	Repair	ON	ORG.	1,149	2.5	218
22593 Ignition Lead	Replace	ON	ORG.	5,882	1.7	29
	Repair	ON	ORG.	10,000	1.1	11
26111 Engine to Trans. Drive Shaft	Replace	ON	ORG.	1,695	3.9	230
	Repair	ON	ORG.	370	4.0	1,088
26210 Main Transmission	Replace	ON	D.S.	1,613	13.9	867
	Repair	ON	ORG.	1,111	3.8	347

TABLE III - Continued						
Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
26411 Tail Rotor Drive Coupling	Replace	ON	ORG.	10,000	0.6	6
	Repair	ON	-	1,818	0.9	53
26413 Hanger Bearing	Replace	ON	ORG.	2,222	2.8	126
	Repair	ON	ORG.	474	2.0	433
26416 Tail Rotor Gearbox	Replace	ON	ORG.	3,226	4.7	147
	Repair	ON	ORG.	331	3.1	943
29310 Droop Compensator	Replace	ON	ORG.	2,857	2.1	73
29411 Oil Cooler	Replace	ON	ORG.	1,695	3.8	224
	Repair	ON	ORG.	2,857	1.0	34
29711 Anti-Ice Control Actuator	Replace	ON	ORG.	4,762	2.2	46
	Repair	ON	ORG.	7,143	1.1	16
42111 Starter Generator	Replace	ON	ORG.	270	2.0	742
	Repair	ON	ORG.	185	1.7	909

TABLE IV. COMPONENT REPAIR AND REPLACEMENT STATISTICS, OH-6 HELICOPTER

Component Code and Nomenclature		Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
14032	Main Rotor Swashplate	Replace	On	D.S.	1,111	7.2	648
15003	Tail Rotor Hub Assembly	Replace	On	D.S.	429	3.2	747
		Repair	Off	D.S.	93	10.0	10,772
		Repair	On	D.S.	9,091	4.3	46
15010	Main Rotor Hub Assembly	Replace	On	D.S.	662	8.3	1,252
		Repair	On	D.S.	185	8.0	4,335
15047	Main Rotor Damper Assembly	Replace	On	Org	316	1.2	375
15153	Tail Rotor Blade	Replace	On	D.S.	4,762	3.8	80
		Repair	Off	-	33,333	1.7	5
22007	Engine	Replace	On	D.S.	169	14.5	8,580
		Repair	Off	D.S.	139	10.0	7,212
		Repair	On	D.S.	885	5.9	665
22044	Power Turbine Governor	Replace	On	D.S.	1,032	3.5	339
22054	Gas Producer Fuel Control	Replace	On	D.S.	633	3.6	569
22062	Oil Cooler	Replace	On	D.S.	1,613	5.1	316
		Repair	On	D.S.	25,000	5.4	24
22110	Engine Oil Filter	Replace	On	Org	860	0.7	85
26013	Main Transmission	Replace	On	D.S.	364	15.6	4,286
		Repair	Off	D.S.	177	7.0	3,955
26017	Tail Rotor Gearbox	Replace	On	D.S.	288	6.7	2,326
		Repair	Off	D.S.	195	4.0	2,064
26019	Main Drive Shaft	Replace	On	D.S.	437	2.4	550
26023	Tail Rotor Drive Shaft	Replace	On	D.S.	498	3.7	774
		Repair	Off	D.S.	212	7.0	932
26126	Bearing Seal-Tail Rotor Gearbox	Replace	On	D.S.	2,041	3.7	181
26187	Oil Filter-Main Transmission	Replace	On	Org	1,667	1.0	60
42055	Starter Generator	Replace	On	Org	699	1.2	172

TABLE V. COMPONENT REPAIR AND REPLACEMENT STATISTICS, UH-1 HELICOPTER

Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
1411B Collective Lever Assembly	Replace	On	Org	1,282	2.1	163
	Repair	On	Org	637	1.9	303
1412B Swashplate/Support Assembly	Replace	On	Org	794	10.0	1,261
	Repair	On	Org	469	3.4	734
14141 Flight Control Cylinder/ Valve	Replace	On	Org	135	3.8	2,808
	Repair	On	Org	118	2.5	2,087
15115 Main Rotor Hub Assembly	Replace	On	Org	298	11.1	3,734
	Repair	On	D.S.	694	17.8	2,561
1511D Scissors/Sleeve Assembly	Replace	On	D.S.	229	5.7	2,489
	Repair	On	D.S.	415	2.0	474
15118 Main Rotor Counterweight	Replace	On	Org	9,091	1.4	16
	Repair	On	Org	2,778	2.0	72
15211 Tail Rotor Hub Assembly	Replace	On	D.S.	130	3.5	3,700
	Repair	Off	D.S.	249	3.9	1,563
	Repair	On	D.S.	532	1.9	360
15212 Tail Rotor Blade Assembly	Replace	On	D.S.	164	3.7	2,262
22700 T-53 Engine	Replace	On	D.S.	281	42.2	15,015
	Repair	Off	D.S.	781	19.2	2,450
	Repair	On	D.S.	315	2.3	715
22261 Fuel Regulator	Replace	On	Org	1,887	7.8	416
	Repair	On	Org	490	1.5	315
22262 Main Fuel Manifold	Replace	On	Org	4,167	5.5	134
	Repair	Off	D.S.	50,000	17.2	28
	Repair	On	Org	2,381	3.0	124
22263 Starting Fuel Manifold	Replace	On	Org	16,667	2.5	16
	Repair	On	Org	2,941	1.2	40
2226310 Starting Fuel Nozzle	Replace	On	Org	6,667	4.4	64
	Repair	On	Org	20,000	4.8	23
22291 Exciter Unit	Replace	On	Org	4,762	1.8	40
	Repair	On	Org	4,762	1.7	35
22293 Igniter Plug	Replace	On	Org	5,556	1.8	32
	Repair	On	Org	4,348	3.7	83
26111 Main Drive Shaft	Replace	On	Org	351	3.5	996
	Repair	Off	D.S.	870	3.7	425
	Repair	On	Org	1,818	3.2	228

TABLE V - Continued						
Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
26211 Main Transmission	Replace	On	D.S.	1,163	31.4	2,691
2621C Mast Assembly	Replace	On	D.S.	935	10.3	1,099
	Repair	On	D.S.	1,449	1.4	98
2621E Main Input Quill-Main Trans	Replace	On	D.S.	909	7.3	803
	Repair	On	D.S.	1,235	5.0	406
2621J Tubing-Main Transmission	Replace	On	Org	9,091	1.3	15
	Repair	On	Org	4,167	1.0	25
2621K Hose-Main Transmission	Replace	On	Org	6,667	1.7	25
	Repair	On	Org	4,167	1.2	28
26411 Tail Rotor Drive Shaft	Replace	On	Org	1,064	1.7	159
	Repair	On	Org	1,597	1.5	98
26413 Tail Rotor Shaft Hanger	Replace	On	Org	340	2.0	589
	Repair	Off	D.S.	909	2.5	272
	Repair	On	Org	1,316	2.6	201
26414 Intermediate Gearbox	Replace	On	Org	617	3.1	501
	Repair	On	Org	735	1.0	135
26415 Tail Rotor Gearbox	Replace	On	Org	410	4.9	1,197
	Repair	On	Org	292	1.6	547
29132 Pillow Block Assembly	Replace	On	D.S.	12,500	1.3	10
	Repair	On	D.S.	4,762	1.3	27
2923E Particle Separator	Replace	On	Org	12,500	1.8	15
	Repair	On	Org	2,128	1.8	84
2931J Droop Compensator Cam Box	Replace	On	D.S.	3,226	2.4	74
	Repair	On	Org	529	1.3	242
2931J10 Linear Actuator	Replace	On	Org	680	2.1	309
	Repair	Off	D.S.	1,538	2.0	127
	Repair	On	Org	382	1.1	280
29321 RPM Warning Detector Box	Replace	On	Org	171	2.4	1,405
	Repair	Off	D.S.	179	1.8	1,000
	Repair	On	Org	310	1.5	474
29421 Oil Tank	Replace	On	Org	6,250	2.1	34
	Repair	On	Org	2,083	1.1	52
29422 Oil Cooler	Replace	On	Org	3,125	3.1	100
	Repair	On	Org	2,381	1.6	68

TABLE V - Continued						
Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-hr	MH/FH $\times 10^{-5}$
29621 Tailpipe	Replace	On	D.S.	9,091	3.1	34
	Repair	Off	D.S.	33,333	2.8	9
	Repair	On	D.S.	12,500	1.0	8
42111 Generator	Replace	On	Org	862	2.7	314
	Repair	On	Org	1,205	2.1	173
42211 Starter Generator	Replace	On	Org	1,239	3.2	259
	Repair	On	Org	1,316	2.0	152

TABLE VI. COMPONENT REPAIR AND REPLACEMENT STATISTICS, AH-1 HELICOPTER

Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBR	Avg Man-Hr	MH/FH x 10^3
14118 Collective Lever Assembly	Replace	On	Org	4,000	1.6	40
	Repair	On	Org	3,442	1.4	42
1412B Cyclic Swashplate/Support Assembly	Replace	On	Org	585	7.5	1,284
	Repair	On	Org	826	4.8	576
14141 Flight Control Cylinder/ Valve	Replace	On	Org	244	3.2	1,309
	Repair	On	Org	303	3.5	1,144
15115 Main Rotor Hub Assembly	Replace	On	Org	347	6.9	1,988
	Repair	Off	D.S.	685	11.7	1,715
	Repair	On	Org	408	1.5	366
15211 Tail Rotor Hub Assembly	Replace	On	D.S.	247	3.6	1,458
	Repair	Off	D.S.	706	2.5	335
15212 Tail Rotor Blade Assembly	Replace	On	D.S.	478	3.7	773
	Repair	On	D.S.	2,174	0.9	42
22200 T-53 Engine	Replace	On	D.S.	292	43.0	14,721
	Repair	Off	D.S.	2,381	15.3	641
	Repair	On	D.S.	725	3.0	488
22261 Fuel Regulator	Replace	On	Org	3,030	6.0	200
	Repair	On	Org	800	0.9	114
22277 Oil Hose	Replace	On	Org	2,382	1.3	56
	Repair	On	Org	2,000	0.4	22
26111 Main Drive Shaft	Replace	On	Org	413	3.4	823
	Repair	Off	D.S.	685	3.3	481
2621C Mast Assembly	Replace	On	D.S.	779	8.3	1,978
	Repair	On	D.S.	1,138	1.8	157
2621E Main Input Quill Assembly	Replace	On	D.S.	740	6.4	855
	Repair	On	D.S.	2,381	3.8	157
2621J Tubing - Main Transmission	Replace	On	Org	25,000	1.1	5
	Repair	On	Org	7,692	1.3	17
2621K Hose-Main Transmission	Replace	On	Org	5,882	1.4	23
	Repair	On	Org	5,882	0.6	10
26211 Main Transmission Assembly	Replace	On	D.S.	1,087	27.2	2,500
26411 Tail Rotor Drive Shaft Assembly	Replace	On	Org	427	1.6	374
	Repair	On	Org	885	1.0	114

TABLE VI - Continued

Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
26413 Hanger Assembly	Replace	On	Org	88	1.9	2,150
	Repair	Off	D.S.	312	1.8	595
26414 Intermediate Gearbox	Replace	On	Org	427	2.6	608
	Repair	On	Org	885	0.8	86
26415 Tail Rotor Gearbox Assembly	Replace	On	Org	369	4.8	1,303
	Repair	On	Org	629	0.8	129
29132 Pillow Block Assembly	Replace	On	D.S.	4,000	1.3	33
	Repair	On	D.S.	7,692	0.9	11
29133 Tripod Assembly	Replace	On	D.S.	1,408	2.0	142
	Repair	On	D.S.	1,493	1.5	103
2931J Droop Compensator Cam Box	Replace	On	Org	3,030	2.3	77
	Repair	On	Org	452	0.7	155
2931J10 Linear Actuator	Replace	On	Org	452	2.3	509
	Repair	Off	D.S.	1,205	1.2	101
	Repair	On	Org	303	1.0	346
29321 RPM Warning Detector Box	Replace	On	Org	201	2.4	1,193
	Repair	Off	D.S.	224	1.1	493
	Repair	On	Org	189	1.2	635
29422 Oil Cooler	Replace	On	Org	3,448	4.2	123
	Repair	On	Org	3,030	2.6	87
42211 Starter/Generator	Replace	On	D.S.	1,587	3.3	207
	Repair	On	D.S.	826	2.2	269
575C1 SCAS Control Assembly	Replace	On	D.S.	4,000	2.0	50
	Repair	On	D.S.	4,762	1.1	24

TABLE VII. COMPONENT REPAIR AND REPLACEMENT STATISTICS, CH-47 HELICOPTER

Component Code and Nomenclature		Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
14021	Swashplate Control	Replace	On	D.S.	357	14.1	3,952
		Repair	Off	D.S.	1,961	12.0	608
14060	Drive Arm Assy - Trans.	Replace	On	D.S.	324	1.8	555
		Repair	Off	D.S.	1,493	6.0	403
15008	Rotary Wing Head Assy.	Replace	On	D.S.	110	10.8	9,839
		Repair	Off	D.S.	400	80.0	20,039
15102	Shock Absorber	Replace	On	Org	332	2.3	693
15133	Rotary Head Boot Assy.	Replace	On	Org	228	1.9	833
		Repair	On	Org	2,564	1.5	60
15170	Rotary Wing Head Oil Tank	Replace	On	Org	256	1.2	469
15234	Spring Droop Stop	Replace	On	Org	840	1.7	203
15271	Droop Stop-Static	Replace	On	Org	8,333	1.6	19
		Repair	On	Org	12,500	1.0	8
22004	Turbine Engine	Replace	On	D.S.	78	77.6	99,847
		Repair	Off	D.S.	200	79.9	39,930
22074	Fire Detection Sensing Element	Replace	On	Org	121	1.7	1,407
		Repair	On	Org	1,667	2.3	137
22161	Engine Oil Pump	Replace	On	Org	1,639	5.4	330
		Repair	On	Org	7,692	2.0	27
22128	Power Turbine Control Actuator	Replace	On	Org	575	2.3	400
22157	Engine Starter	Replace	On	Org	465	2.6	558
22310	Engine Exhaust Cone	Replace	On	Org	1,923	1.7	89
22357	Engine Tailpipe Assy.	Replace	On	Org	10,000	1.8	19
24009	Aux, Power Unit	Replace	On	Org	192	5.4	2,818
		Repair	On	Org	1,351	2.0	150
		Repair	Off	D.S.	645	117.7	18,250
24169	APU Hydraulic Pump-Motor	Replace	On	Org	3,704	3.1	90
		Repair	Off	D.S.	7,692	18.9	253
24304	APU Fuel Pressure Switch	Replace	On	Org	3,226	1.4	44

TABLE VII - Continued						
Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
24576 APU Fuel Boost Pump	Replace	On	Org	4,167	1.8	43
26010 Combining Trans.	Replace	On	D.S.	183	7.6	4,160
	Repair	On	D.S.	699	1.2	16
	Repair	Off	D.S.	637	23.9	3,757
26012 Synchronizing Shaft Assy	Replace	On	Org	131	2.4	1,837
26013 Aft Trans. Assy.	Replace	On	D.S.	274	42.6	15,563
	Repair	On	D.S.	140	0.2	214
26016. Forward Trans.Assy	Replace	On	D.S.	407	39.0	9,594
	Repair	On	D.S.	1,429	0.5	39
	Repair	Off	D.S.	1,163	24.0	2,075
26017 Engine Trans.Assy	Replace	On	Org	211	4.5	2,134
	Repair	Off	D.S.	204	12.2	4,026
26019 Trans. Shaft Assy	Replace	On	D.S.	407	2.1	517
	Repair	Off	D.S.	1,754	13.9	737
26038 Aft Rotor Drive Shaft	Replace	On	D.S.	893	19.7	2,202
	Repair	On	D.S.	6,667	2.6	39
	Repair	Off	D.S.	3,030	10.4	340
26084 Adapter Assy - Rotor Drive	Replace	On	D.S.	1,639	2.2	134
	Repair	Off	D.S.	1,020	8.0	787
26086 Output Seal-Aft Trans.	Replace	On	Org	465	15.0	3,220
26173 Chip Detector-Engine Trans	Replace	On	Org	1,389	1.1	79
	Repair	On	Org	3,226	1.1	34
42054 A/C Generator	Replace	On	Org	441	1.8	408
	Repair	On	Org	1,493	9.9	663
45011 Hydraulic Servo Cylinder	Replace	On	Org	225	3.7	1,644
	Repair	Off	D.S.	141	12.0	8,481

TABLE VIII. COMPONENT REPAIR AND REPLACEMENT STATISTICS, CH-54 HELICOPTER

Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
15006 Tail Rotor Blade	Replace Repair Repair	On On Off	Org D.S. D.S.	114 83 63	2.9 2.3 16.0	2,544 3,996 25,513
15007 Main Rotor Head Assembly	Replace	On	D.S.	260	28.7	11,055
15016 Rotor Damper Assembly	Replace Repair	On Off	Org D.S.	311 1,042	3.2 16.0	1,031 1,541
15021 Tail Rotor Head	Replace Repair	On On	Org Org	323 3,125	9.8 3.3	3,041 107
15079 Droop Restrainer	Replace	On	Org	228	1.5	658
15208 Bearing - Pitch Change Link	Replace	On	Org	360	1.4	390
22005 Engine	Replace Repair Repair	On On Off	D.S. D.S. D.S.	85 199 407	52.8 6.9 84.0	62,135 3,473 19,6[illegible]
22028 Tailpipe Assembly	Replace Repair	On On	D.S. D.S.	88 781	1.8 2.4	2,042 311
22037 Fuel Control	Replace	On	D.S.	444	6.4	1,438
22043 Particle Separator	Replace	On	Org	1,333	5.5	412
22100 EAPS Blower	Replace	On	Org	667	3.4	510
22113 Anti-Ice Valve	Replace	On	Org	667	1.3	195
22150 Starter	Replace	On	Org	1,333	2.6	195
22389 Anti-Ice Sensor	Replace Repair	On On	Org Org	4,763 9,091	1.9 0.5	41 5
24014 APP Engine	Replace Repair	On On	D.S. D.S.	4,762 719	6.4 60.0	137 8.346
24038 APP Clutch	Replace Repair Repair	On On Off	D.S. D.S. D.S.	621 4,762 1,553	2.3 2.8 16.0	370 59 1,027
24090 APP Fuel Control	Replace	On	Org	518	3.4	655
24159 APP Starter	Replace	On	Org	781	3.1	396
24187 APP Fuel Pump	Replace	On	Org	3,125	4.4	141

TABLE VIII - Continued

Component Code and Nomenclature	Type Action	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
26011 Main Transmission	Replace	On	D.S.	444	97.7	21,992
26019 Tail Rotor Gearbox	Replace Repair	On Off	D.S. D.S.	407 1,887	20.8 24.0	5,119 1,284
26029 Tail Rotor Drive Shaft Bearing	Replace	On	D.S.	126	4.7	3,721
26040 Main Input Seal-Main Transmission	Replace	On	D.S.	360	9.2	2,559
26042 Intermediate Gearbox	Replace Repair	On On	D.S. D.S.	549 847	7.1 2.8	1,294 330
26066 Oil Pump - Main Transmission	Replace	On	D.S.	719	5.0	695
26083 Rotor Brake Seal - Main Transmission	Replace	On	D.S.	467	7.1	1,519
26112 Brake Disc - Main Transmission	Replace	On	D.S.	621	3.9	628
26224 Tail Rotor Shaft Assembly	Replace	On	D.S.	1,031	2.6	252
26260 Chip Detector- Tail Rotor Gearbox	Replace Repair	On On	Org Org	3,125 1,887	1.6 1.8	51 94
26329 Tail Rotor Shaft Assembly (No. 2-6)	Replace	On	D.S.	1,887	2.5	134
42134 Generator	Replace	On	Org	292	2.0	685
45010 Main Rotor Servo Unit	Replace Repair	On Off	D.S. D.S.	246 85	3.2 16.0	1,301 18,832
57027 AFCS Servo Unit	Replace Repair	On Off	Org D.S.	1,333 1,887	7.1 16.0	532 856
57420 AFCS Amplifier	Replace	On	Org	4,762	1.1	24

MAINTENANCE TASK TIME ANALYSIS

The maintenance requirements for each component were next examined to identify the significant man-hour consuming tasks. These tasks were then to be analyzed individually to determine the proportion of total task time expended on the specific task elements.

The intent, initially, was to analyze both component repair and replacement actions. It became quickly apparent, however, that tasks other than component removal and replacement could not practicably be treated in an analysis of this type. Examination of the maintenance requirements data revealed in nearly all cases repair tasks on each component. Attempts to identify the nature of the repair tasks were rarely successful, however, because of the limited definition provided in the data. A gearbox may have, for example, reflected a significant incidence of repairs for leaks. The leaks may have been in one or more of several seals, in one or more of many attaching lines and hoses, in the filler port, etc. The repair may have been as simple as tightening a bolt or connection or as complex as replacing a rotating seal. Since all repairs of this type are merged together by virtue of the code systems used, there was no way to establish which types of repairs were actually made, their relative frequency, or man-hour cost. Even if this were possible, the number of different repair tasks to be analyzed would easily order in the hundreds.

Further complicating the problem is the diversity existing among basically similar repairs. Repair or rework of a component may be simple and straightforward on one occasion and complex and time-consuming on the next (as when internal parts are found corroded and seized upon disassembly). It is difficult, in many cases to speak of a "typical repair".

The problem of establishing the nature of repair tasks on the helicopter also appeared in the course of the field surveys which took place later in the program. A typical case would involve a high incidence of reported repairs on a component (based on examination of field data), but no authority for repair of that component in the Maintenance Allocation Chart for the helicopter. When asked, Army maintenance personnel would agree that no repair of the component was authorized. The reported cases of repair were usually attributed to faulty data, e.g., replacement of a tail rotor pitch link recorded as "repair" of the tail

rotor installation. At times, field personnel would indicate that minor tasks were performed on the component (tightening a loose fitting, touching up surface corrosion, etc.), but these were not considered in the nature of a "repair" as such. Overall, the consensus was that the majority of corrective actions on the aircraft involved replacement of components or parts.

For these reasons, the maintenance task time analysis was concentrated on removal and replacement actions. These actions, for the most part, are relatively consistent from one occurrence to the next. Unusual difficulties may be encountered in any maintenance task, of course, but the basic steps are relatively the same in each instance. Therefore, the elements of time in removal or replacement of a component may be considered fairly standard, except for the element of fault isolation, which will vary with the type of failure which precipitated the replacement. If replacement was occasioned by excessive corrosion, for example, the fault was probably discovered via a routine visual examination and troubleshooting time was little or none. If, on the other hand, replacement was the result of tracking down an aircraft vibration to a malfunction in that component, troubleshooting time might be a considerable part of the overall task.

The approach, therefore, was to analyze the basic removal or replacement task (no-defect) and then to allocate time to fault isolation for specific kinds of malfunctions (or groups of similar malfunctions). The fault isolation times were later averaged.

For each of the selected components, a technical analysis of the replacement task was made. This involved researching technical manuals, maintenance handbooks, troubleshooting charts, etc., to establish the component's function in the system and its packaging and location in the installation.

Maintenance task steps were then identified and constructed for the removal and installation of the component. These maintenance task steps, sequentially listed in order of their occurrence, identified the major work effort associated with no-defect replacements of the component. The maintenance time required to accomplish each step was then analytically developed and recorded. The analysis relied heavily on the judgement of experienced maintainability engineers supplemented by actual hardware examinations and task observations where possible. Each step in

The maintenance action was then assigned to one of the eight task element categories listed below:

1. Fault isolation (troubleshooting).

2. Gaining access and securing doors, panels, fairing, etc.

3. Removal and replacement of other components for accessibility to the component in need of replacement.

4. Removal and replacement of buildup components.

5. Removal and replacement of the end assembly component.

6. Draining and refilling of fluid supplies (oil, hydraulic fluid, etc.) and servicing or lubrication after repair or replacement.

7. Adjustment, alignment, balancing, tracking, etc. after repair or replacement.

8. Inspection during and after repair or replacement and final test.

Table IX contains a typical component replacement task time analysis - the UH-1 helicopter tail rotor assembly (an illustration of the installation is shown in Figure 30). The man-minutes required for the removal and installation functions are shown assigned to one of the eight task element categories (slash indicates that minutes are split between two categories). The numbers in parentheses refer to figure numbers from the technical manual.

Component replacement task time analyses, thus developed for each of the six helicopter models, were tabulated for discussion and verification in the field survey interviews which followed.

TABLE IX. TYPICAL TASK TIME ANALYSIS, UH-1 TAIL ROTOR REPLACEMENT

Removal Tasks	Remove Minutes	Install Minutes	Task Element
1. Disconnect pitch change link (1) from each tail rotor blade grip pitch horn by removing nut, bolt and washers.	10		3
2. Remove crosshead (4) and shim (5) by removing two attaching bolts with nuts and washers.	6		3
Cut lockwire on each end of boot.	2		3
3. Remove cotter pin, nut and washer from end of pitch change rod. Remove bearing set (6), retainer plate (7), and pitch change slider (8). Remove boot (9).	8		3
4. Cut lockwire and remove hub retainer nut (10). Remove static stop (11) and shim (12).	7		5
5. Move tail rotor hub and blade assembly (13) outboard on splines of shaft, and remove split cone set (14). Remove tail rotor over end of gearbox shaft (15).	8		5

TABLE IX - Continued

Installation Tasks	Remove Minutes	Install Minutes	Task Element
1. Position tail roto hub and blade assembly (13) near end of shaft (15). ᴾ gn master splines and slide hub on shaft il trunnion is started on second set of splines.		8	5
2. Place split con: set (14) in groove on shaft. Slide hub inboard to seat trunnion on cones.		6	5
3. Inspect cone set for spacing.		6	8
4. Install shim (12) on shaft. Install static stop (11) and hub retaining nut (10) and tighten.		5	5
5. Lockwire nut and install boot (9) on shaft.		2/4	5/3
6. Install slider (8) on shaft (15). Safety wire each end of boot. Place retainer plate (7) and bearings (6) on end of pitch change rod (16), secure by washer and nut.		9	3
7. Determine thickness of shim (5) required on pitch change rod bearings.		4/12	7/8

TABLE IX - Continued

Installation Tasks -Continued	Remove Minutes	Installed Minutes	Task Element
8. Fill crosshead cavity with grease. Place shim and crosshead over bearings. Align parts, install bolts with washers through crosshead, shim, retainer plate, and flange of slider.		12	5
9. Install pitch change links (2) in crosshead.		12	3
10. Connect each pitch change link to blade pitch horn.		9	3
11. Check tail rotor clearance, and controls for free movement.		14/12	7/8
12. Lubricate tail rotor.		5	6
13. Track tail rotor		30	7

FIELD SURVEYS

Field surveys were conducted at five Army aviation maintenance activities operating and maintaining the six helicopter models under study. The schedule for these visits is shown in Table X.

The purpose of the field survey was twofold. The first objective was to compare the analytical findings of the Kaman technical staff with the experience and judgment of Army maintenance specialists in the field. The second objective was to gain a deeper insight into the maintenance requirements of the various aircraft, especially from a qualitative standpoint.

Each field visit involved interviews with Army maintenance specialists, examination of aircraft and, where possible, the observation of actual maintenance operations. Each survey was centered around interviews in which experienced Army maintenance specialists in power plants, drives, rotors, etc., were asked to supply maintenance estimates based on personal experience. Two Kaman maintainability engineers participated in each survey which allowed the interviewing to be conducted along aircraft subsystem lines. The Contracting Officer's Technical Representative from AAMRDL arranged and attended each field visit, scheduling the interviews for overall working efficiency.

Figures 11, 12 and 13 show the format of the field questionnaire forms used. The first form recorded general information about the survey, such as the unit visited, levels of maintenance covered, and persons interviewed. The forms shown in Figures 12 and 13 were used to record detailed information on the individual components. The interview technique required that the person being interviewed provide estimates with no prior knowledge of the analytical estimates developed by Kaman personnel. This was done to avoid any tendency to simply agree with Kaman's analysis.

The procedure for conducting the interview was generally as follows. The person being interviewed was first asked to give his opinion of the three most frequent causes for replacement of the component (TBO, leaks, internal failure, etc.). He was then asked to rank the three causes for removal in descending order by estimated frequency of occurrence. The maintenance level at which the action was

TABLE X. FIELD SURVEY SCHEDULE

Operating Unit	Helicopter Model	Dates
First Air Cavalry, 7th Squadron, Fort Knox, Kentucky	OH-58	October 24 thru 25 1972
First Air Cavalry Maintenance Battalion, Hunter AAF, Savannah, Georgia	UH-1 AH-1	November 14 thru 16 1972
178th Aviation Company, Fort Sill, Oklahoma	CH-47	January 9 thru 11, 1973
355th Aviation Company (HH), Fort Eustis, Virginia	CH-54	January 23 thru 24 1973
Army National Guard Unit Byrd Airport Richmond, Virginia	OH-6	January 26, 1973

performed and the MOS of the maintenance personnel who normally performed the action were also requested. Next, the person interviewed was asked to estimate the crew size and average man-hours involved in the replacement action. It was explained that the estimate could vary for the three removal causes listed, depending upon the condition of the item after failure, the amount of troubleshooting involved with different failure modes, etc. Lastly, it was requested that the three most time-consuming elements of each replacement task be identified. This was recorded via a ranking number entered in the blocks in the lower half of the form. (Originally, percentage of total estimates were requested, but this was found to be impractical.) Again, it was explained that the ranking could vary among the three replacement actions, depending upon the nature of the tasks involved.

After the first sheet was completed, the Kaman maintainability engineer would compare the responses received with his analysis of the maintenance action. Where significant variances were found, the engineer would first make certain that there was a mutual understanding of the overall task being evaluated and the interpretation of work allocated to the various maintenance time elements. In some cases, the maintenance action analysis was reviewed step-by-step to identify the areas in which significant disagreement in time estimates had occurred. Adjustments in either the Kaman analysis or the interview responses were often made at this point.

The second sheet of the interview form was usually completed at the aircraft. The person being interviewed would be asked to comment on factors he felt contributed most importantly to the maintenance time elements he had ranked earlier. This normally involved looking at the hardware in question as comments were being recorded. Particular emphasis was placed on gross differences in time estimates which had not been adequately reconciled in the earlier desk session.

The field surveys were a very important phase of the total study. They served to provide insights into maintenance problems not obtainable through an analysis of data alone. In some cases, the analysis of maintenance task time was modified substantially as a result of acquiring a better understanding of the maintenance function through these interviews.

FIELD SURVEY QUESTIONNAIRE

Helo Model: UH-1

Maint.Level: Org. and D.S.

Date: Oct.24-25, 1972

Location: First Air Cavalry, Hunter AAF, Savannah, Georgia

PERSONS INTERVIEWED:

1. Name and Rank/MOS: John Doe, Spec 5

   Military Unit: A-Company, Aircraft Maint.Bat.

   Duty or Function: Crew Chief

   Maintenance Experience: UH-1 (2 yrs.), AH-1 (2 yrs)

2. Name and Rank/MOS: John Smith, Spec 6

   Military Unit: B-Company, Aircraft Maint.Bat.

   Duty or Function: NCOIC, Prop & Rotor Shop

   Maintenance Experience: UH-1 (4 yrs), AH-1 (2 yrs), CH-47 (1 yr), CH-34 (6 yrs)

3. Name and Rank/MOS: __________

   Military Unit: __________

   Duty or Function: __________

   Maintenance Experience: __________

Figure 11. Field Survey Questionnaire, General Data.

EVALUATION OF COMPONENT TASK TIME Page 1

Component WUC 2621C Nomenclature Mast Assembly Model UH-1

Reason for Maintenance/Failure Mode	Freq. Rank	Level	MOS	Avg. Man Hours	Avg. Crew
1. Noisy mast bearing	1	D.S.	67N20	8.0	2
2. Nicks, scratches	3	D.S.	67N20	8.5	2
3. Leaking	2	D.S.	67N20	8.0	2

Elements of Maintenance Time

Action	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
1			1		2			
2	3		1		2			
3			1		2			

Figure 12. Field Survey Questionnaire, Page 1.

EVALUATION OF COMPONENT TASK TIME   Page 2

Component WUC 2621C Nomenclature Mast Assembly Model UH-1

1 Short length of tubing is used to listen for excessive bearing noise while helo is running. Suggest that stethescope be included in mechanics tool box to facilitate this check.

3 When mast boot becomes torn, it is difficult to replace. Rotor must be removed. Suggest split-type boot. (H-34 has zippered mast dust cover).

2 Scratches are difficult to measure depth. Need better measurement device than dial indicator with flat plate and stylus. Many times precautionary mast replacements are made for lack of good method of checking scratch depth. Also suggest protective coating to better protect mast from scratches.

Figure 13. Field Survey Questionnaire, Page 2.

COMPONENT REPLACEMENT TASK DATA

FORMAT AND CONTENT

Component replacement time data developed from the analyses and field work previously described is presented in six tables by helicopter model as follows:

Table XI	Component Replacement Data, OH-58 Helicopter
Table XII	Component Replacement Data, OH-6 Helicopter
Table XIII	Component Replacement Data, UH-1 Helicopter
Table XIV	Component Replacement Data, AH-1 Helicopter
Table XV	Component Replacement Data, CH-47 Helicopter
Table XVI	Component Replacement Data, CH-54 Helicopter

Each table is organized sequentially by component code. The data presented for each component includes a quantitative breakdown of the replacement time elements and, where pertinent, a statement of the factors which were found to influence the time involved in certain tasks. A two-line presentation of the task time elements is used. The first line shows the average total man-hours required for replacement of the component and the apportionment of this time among the eight task elements. The percent contribution of each element to the total replacement task is shown on the second line. Where factors pertinent to one or more of the task elements are given, a third line lists the number of the footnote(s) which applies to that element. The footnotes for a component are grouped at the bottom of the table on the same page.

The component replacement time factors presented in this study are averages developed from examination of historical data, detailed task time analyses, and the judgment of skilled and experienced field maintenance personnel. The average time to accomplish component replacement considers direct maintenance functions only. It excludes other contributors to maintenance time such as administrative and supply delays, lost time, record keeping, etc. As such, the maintenance time averages may appear somewhat lower than published averages which reflect "start-to-finish" times. Originally, it was intended that the total maintenance time be considered in this analysis. Attempts to obtain reasonable time estimates

for indirect maintenance functions such as locating equipment, chasing parts, completing forms, etc., were not successful, however. It was found that the time expended in such functions varied widely from one aircraft maintenance operation to another. The average time required to obtain parts was reported to vary from a few minutes to upwards of an hour (in the case of a unit whose supply source was across the airfield several miles from the maintenance base). Similarly, estimates of time for obtaining work stands, a crane, external power source, etc., were found to vary greatly, depending upon the relative abundance or scarcity of such equipment at that activity. Any estimate of the "average" time involved in such tasks would be very subjective and serve only to make the total time for replacement appear more reasonable and in keeping with other published statistics. Such data would, moreover, contribute nothing to the basic objectives of the study. For these reasons, replacement task time analysis was confined to the "wrench turning" aspects of the job.

Even in this area, however, some difficulty was encountered in arriving at average maintenance times. Occasionally, the engineering task time analysis of a component replacement function would develop an estimate of total man-hours which was at gross variance with the average man-hours generated from the field data (TAMMS or 3-M). When this occurred, one or both of two conclusions might be considered. Either the field data was erroneous and/or the engineering task time analysis was faulty. The first step in resolving the conflict involved a thorough analysis of the field data using the detailed maintenance action reports shown in Figure 6. Very often, cases of improperly coded data could be substantiated, as when replacement of a helicopter main gearbox was reported to consume 1.5 man-hours. An error such as this might have occurred in preparation of the original maintenance report or in the translation of the data to machine-readable format. Most often, it represented a case of improper code selection (use of the gearbox code or part number to report replacement of an oil fitting for example). When a sufficient number of erroneous reports could be identified in the data for a component, it was usually possible to resolve major differences between the computer-generated statistics and the engineering analysis. When this failed to resolve the conflict satisfactorily, the engineer would review his analysis to confirm that his detailed task time estimates were valid and complete. Adjustments were made as necessary at this point.

In the course of the field interviews, disagreement between the engineering analysis and the time estimates of field

personnel also occurred. These resulted frequently from conflicting interpretations of the maintenance task being considered, especially in the classification of time among the eight task elements, and were usually resolved through discussion. Not infrequently, the discrepancy was the result of over-estimating or under-estimating the time for certain tasks in the engineering analysis. The opportunity to discuss maintenance tasks with experienced field personnel while examining the actual hardware installation was extremely valuable in this regard. Very often, problems indicated by an analysis of maintenance instructions and installation drawings were found to be much less severe when actually viewed and discussed. Likewise, some problems overlooked in the technical analysis were revealed in this manner. Replacement time estimates were frequently modified as a result of the field survey.

The component replacement time factors developed from this study are the best overall averages established by skilled analysts using the various sources of information available to this program. Maintenance time is, however, a variable quantity. It is influenced by the environment in which people work and by the maintenance resources available to them. It is influenced also by their skill, motivation and morale, by the quality and depth of supervision and by the policies of management. The concept of an "average maintenance time" must be viewed within this context. Higher or lower averages may prevail where the physical or psychological factors influencing maintenance performance move in either direction from the norm.

The emphasis in this study has been on the quantification of maintenance time in terms of discrete task elements. Establishing the time structure of major maintenance tasks isolates the elements of work which contribute most to the overall man-hour expenditure. However, there are factors involved in the performance of maintenance tasks which time statistics alone do not reveal. One additional requirement of the Government's work statement for this project was to identify the more important of these. This has been done by way of the notes appended to the statistical data in each table.

In the course of this study, many facts and opinions were brought to the attention of the analysts doing the research, either through their own analysis or from the field personnel they interviewed. Often this data was totally or partially unrelated to the subject of the study. In other cases, the data was relevant but was found to be unique to problems at a particular facility or with a special group of aircraft.

Thus, it was necessary to carefully review the collected data and to selectively extract the more significant information for inclusion in this report. The footnotes which accompany each table are the result of this screening, the comments considered most important to the immediate goals of this study. There is obviously much more information of a qualitative nature available on the maintenance of components covered by this study. Much of this would be necessary to any in-depth study of maintenance problems flowing from this initial investigation.

Figures have been used to illustrate some of the more important comments. They are found grouped at the end of the table for each model helicopter. Appendix IV contains historical maintenance data for each of the components contained in this section.

TABLE XI. COMPONENT REPLACEMENT DATA, OH-58 HELICOPTER

Component Code and Nomenclature		Task Element								
		Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
14123 Swashplate/ Support Assembly	Man-Hr	6.2	0.8	0.3	2.5		2.0	0.1		0.5
	Percent		12.9	4.8	40.3		32.3	1.6		8.1
	Note			(1)			(2)			
14142 Cyclic Servo Actuator	Man-Hr	2.5	0.5	0.2			1.0	0.3		0.5
	Percent		20.0	8.0			40.0	12.0		20.0
	Note			(3)			(4)			
14144 Collective Servo Actuator	Man-Hr	2.7	0.5	0.2			1.2	0.3		0.5
	Percent		18.5	7.4			44.4	11.1		18.5
	Note			(5)			(4)			

(1) The nature of the design and its inherent function and location require removal and installation of a number of other components for replacement of this assembly. These components consist of: (1) main rotor hub and blade assembly, (2) lever and idler link, (3) boot, (4) collar set, and (5) retainer ring. (Figure 14)

(2) Removing and installing the eight nuts and washers attaching the assembly to the transmission, particularly the nut and washer located below the collective lever, is time-consuming. (Figure 14)

(3) The actuators are packaged in a desirable work area, permitting good access for both visual and manipulative maintenance functions. This facilitates checking for leaks, making repairs and replacements, and servicing (wiping) actuator pistons. Because of an anticipated higher failure rate than the collective servo actuator, these actuators are positioned outboard for accessibility.

(4) Numerous pieces of attaching hardware are required for mounting the actuators. (Figure 15)

(5) The collective servo actuator is located inboard where it is somewhat less accessible for maintenance than the cyclic actuator. (Figure 15)

TABLE XI - Continued

Component Code and Nomenclature		Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
15111 Main Rotor Hub	Man-Hr	7.4	0.8		3.1		1.8	0.2	1.0	[illegible]
	Percent		10.8		41.9		24.3	2.7	13.5	[illegible]
	Note						(1)			
15114 Hub Grip Reservoir	Man-Hr	0.7	0.2				0.3	0.1		0.1
	Percent		28.6				42.9	14.3		14.3
	Note						(2)	(3)		
15211 Tail Rotor Hub	Man-Hr	5.4	0.3		3.1		0.8	0.1	0.8	0.3
	Percent		5.6		57.4		14.8	1.9	14.8	5.6
	Note				(4)		(4)		(5)	

(1) Frequently the main rotor blade retention bolt is difficult to remove. Corrosion, possibly resulting from failure to apply corrosion preventive compound when originally inserting this bolt, causes bolt seizing. When this occurs, a mallet and drift pin are required for releasing the bolt and removing the main rotor blades. (Figure 16)

(2) Over torquing of the bolt attaching reservoir, stat-o-seal, sight glass, and packings to the main rotor hub grips have caused cracked sight glasses, reservoir cases, and deformed seals. This results in oil leaking from reservoirs and requires replacement of component or damaged parts.

(3) Pressure vent cap on top of relief plug partially covers the plugs wrenching flats and restricts application of wrench for plug removal and installation. (Figure 16)

(4) Replacement entails disconnecting, connecting, removing, installing, and accounting for numerous parts and associated hardware. In addition, three specific torque values are required during the installation process. (Figure 17)

(5) Bonded laminates of shim are required to maintain clearances within specific tolerance. Disassembly and reassembly of the hardware is sometimes necessary to obtain proper shimming.

TABLE XI - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
15215	Tail Rotor Blade	Man-Hr	4.4	0.3		2.0	1.0	0.5		1.3	0.3
		Percent		6.8		45.5		11.4		29.5	6.8
		Note				(1)				(2)	
22500	T63 Engine	Man-Hr	28.9	1.5	0.5	3.4	16.0	5.8	0.7	0.3	0.7
		Percent		5.2	1.7	11.8	55.4	20.1	2.4	1.0	2.4
		Note					(3)				
22561	Fuel Pump	Man-Hr	2.8	0.8	0.2		0.6	0.9			0.3
		Percent		28.6	7.1		21.4	32.1			10.7
		Note					(4)	(5)			

(1) Procedures require removal of the tail rotor hub and blades as a unit in order to replace blades. (Figure 17)

(2) On later model aircraft, provisions are made to facilitate dynamic balancing of the tail rotor on the aircraft. (Figure 17)

(3) The buildup of replacement engines includes removal of accessories from the old engine for installation on the replacement engine. This engine teardown and buildup process is time-consuming. The high expenditure of maintenance time is attributed to the number of accessories involved, their mounting position, routing of plumbing and location of associated fittings, and the restricted access to attached linkage and parts. (Figure 18)

(4) Removal of fittings from the removed pump for buildup of the replacement pump is required.

(5) Two sizes of coupling nuts connect lines to the fuel pump. Each size has a specific torque value.

TABLE XI - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22562	Main Fuel Control	Man-Hr	3.4	0.8	0.2		0.6	1.2	0.1	0.2	0.3
		Percent		23.5	5.9		17.6	35.3	2.9	5.9	8.8
		Note					(1)	(2)			
22563	Governor	Man-Hr	3.0	0.8	0.2		0.4	1.2	0.1		0.3
		Percent		26.7	6.7		13.3	40.0	3.3		10.0
		Note						(3)			
22566	Fuel Check	Man-Hr	2.2	0.5	0.2			0.3	1.0		0.2
		Percent		22.7	9.1			13.6	45.5		9.1
		Note							(4)		
22572	Lube Filter	Man-Hr	1.2	0.2	0.2			0.4	0.1		0.3
		Percent		16.7	16.7			33.3	8.3		25.0
		Note						(5)			

(1) Removal of fittings from the old assembly for buildup of the replacement assembly is required.

(2) The uppermost self-locking nut, attaching the fuel control to the gearbox housing is difficult to remove and replace. This attachment point, which is located in a congested area with limited access, also hinders the application of the required torque.

(3) Three different torque values are specified for installation of the governor. These torques are applied to mounting hardware, tube and port coupling nuts, and level linkage nut.

(4) Cleaning consists of soaking the check valve in denatured alcohol for a period of one hour.

(5) A suction gun or other device is used to remove puddled oil from within the filter housing before removal of the filter element.

TABLE XI - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22593	Ignition Lead	Man-Hr	1.7	0.5	0.2			0.8			0.2
		Percent		29.4	11.8			47.1			11.0
26111	Engine-to-Trans. Driv. Shaft	Man-Hr	3.9	0.3	2.7			0.8			0.1
		Percent		7.6	69.2			20.5			2.6
		Note			(1,2)						
26210	Main Transmission	Man-Hr	13.9	0.4	2.0	6.7		3.5	1.2		0.1
		Percent		2.9	14.4	48.2		25.2	8.6		6.7
		Note				(3)			(4)		

(1) The shaft is covered by a two-piece sheet metal shroud and passes through a sheet metal panel all of which is attached to the forward fire wall via numerous phillips head screws. Some screw heads are inaccessible and require use of an offset screwdriver. Screw heads are frequently stripped in the process of removal. (Figure 19)

(2) On those helicopters equipped with armor plating, the plating must be removed to provide access to the shaft. Hardware securing the plating is installed with the hex nuts inboard and completely hidden from view. Also, the nuts are in close proximity to the plating brackets thereby preventing full swing of an open-end wrench or use of a socket wrench.

(3) Due to the arrangement (physical location) of components in the power delivery train to the rotors, many drive, control, and rotor components must be removed to provide access to the main transmission. These include main rotor blades, main rotor hub, swashplate and support assembly and control rods.

(4) Draining the transmission sump involves removal of a plug at the right forward bottom corner of the transmission and allowing oil to run into a locally fashioned trough leading over the side of the aircraft. Spillage is inevitable and much clean-up time is required.

TABLE XI - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26411	Tail Rotor Drive Coupling	Man-Hr	0.6	0.2				0.4			
		Percent		33.3				66.7			
		Note						(1)			
26413	Hanger Bearing	Man-Hr	2.8	0.3			0.7	1.6	0.2		
		Percent		10.7			25.0	57.1	7.1		
		Note						(2,3)			

(1) The laminated steel disc flexible couplings are relatively easy to replace and present only one maintenance problem. Changing the sequence of discs within the stack-up, or changing the orientation of any single disc, renders the coupling unusable. It appears that a simple indexing system, with permanently applied marks, would allow re-stacking of discs in their original order after accidental disarrangement.

(2) The long tail rotor drive shaft is supported by six bearings which all must be slipped onto the shaft from the forward end. Replacement of most aft bearings requires removal of first five bearings.

(3) Each bearing has a self-aligning feature which requires a complicated bearing installation procedure. Initially the bearing is installed in its split-type hanger housing and aligned by eye. Only light torque is applied to the bolt which causes the split housing to compress and grip the bearing. The shaft is installed and aircraft is operated for 15 minutes. Bearing temperature is monitored with heat crayon. If temperature remains normal, alignment is considered proper and specified torque is applied to split housing bolt.

TABLE XI - Continued

Component Code and Nomenclature		Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26416 Tail Rotor Gearbox	Man-Hr	4.7	0.4	0.2	2.7		.9	.4		0.1
	Percent		8.5	4.3	57.4		19.1	8.5		2.1
	Note				(1)					
29310 Droop-Compensator	Man-Hr	2.1	0.3	0.3			1.0		0.3	0.2
	Percent		14.3	14.3			47.6		14.3	9.5
	Note						(2)			
29411 Oil Cooler	Man-Hr	3.8	0.5	0.4			2.0	0.7		0.2
	Percent		13.2	10.5			52.6	18.4		5.3
	Note						(3)			

(1) Replacement of the tail rotor gearbox requires removal of the tail rotor hub and blade assembly. Balance of the tail rotor must be checked during reinstallation. Later model helicopters were delivered with a balance wheel installed as part of the tail rotor hub to facilitate dynamic balancing of the tail rotor. (Figure 17)

(2) The torque tube assembly, 206-062-708-5, is located in a position which is vulnerable to damage from maintenance and servicing personnel. These tubes are frequently replaced as a result of being bent and distorted. The probable cause of this damage is from being stepped on or hit by tools or other objects. (Figure 20)

(3) Oil cooler replacement requires removing and replacing thirteen (13) bolts and washers attaching the cooler to the duct extension.

TABLE XI - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove Install Buildup Items	Remove Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
29711	Anti-Ice Control Actuator	Man-Hr	2.2	0.4	0.4		0.2	1.0		0.1	0.1
		Percent		18.2	18.2		9.1	45.5		4.5	4.5
		Note						(1)			
42111	Starter Generator	Man-Hr	2.0	0.3	0.4	0.2		0.8	0.1		0.2
		Percent		15.0	20.0	10.0		40.0	5.0		10.0
		Note						(2,3)			

(1) Spacers are utilized to mount the actuator and its bracket to the engine mounting pad for clearance of control lever movement during removal and replacement of the actuator. These spacers are easily dropped and misplaced, and become loose hardware within the engine compartment.

(2) The starter/generator must be properly supported whenever the attaching clamp is loosened or until the clamp has been installed and properly torqued. Maintenance induced damage has occurred to the shaft when the unit is allowed to support its own weight.

(3) The electrical connection consists of five individual leads. Each lead must be disconnected and reconnected when replacing the component. In addition, each lead must be protected by electrical tape while disconnected.

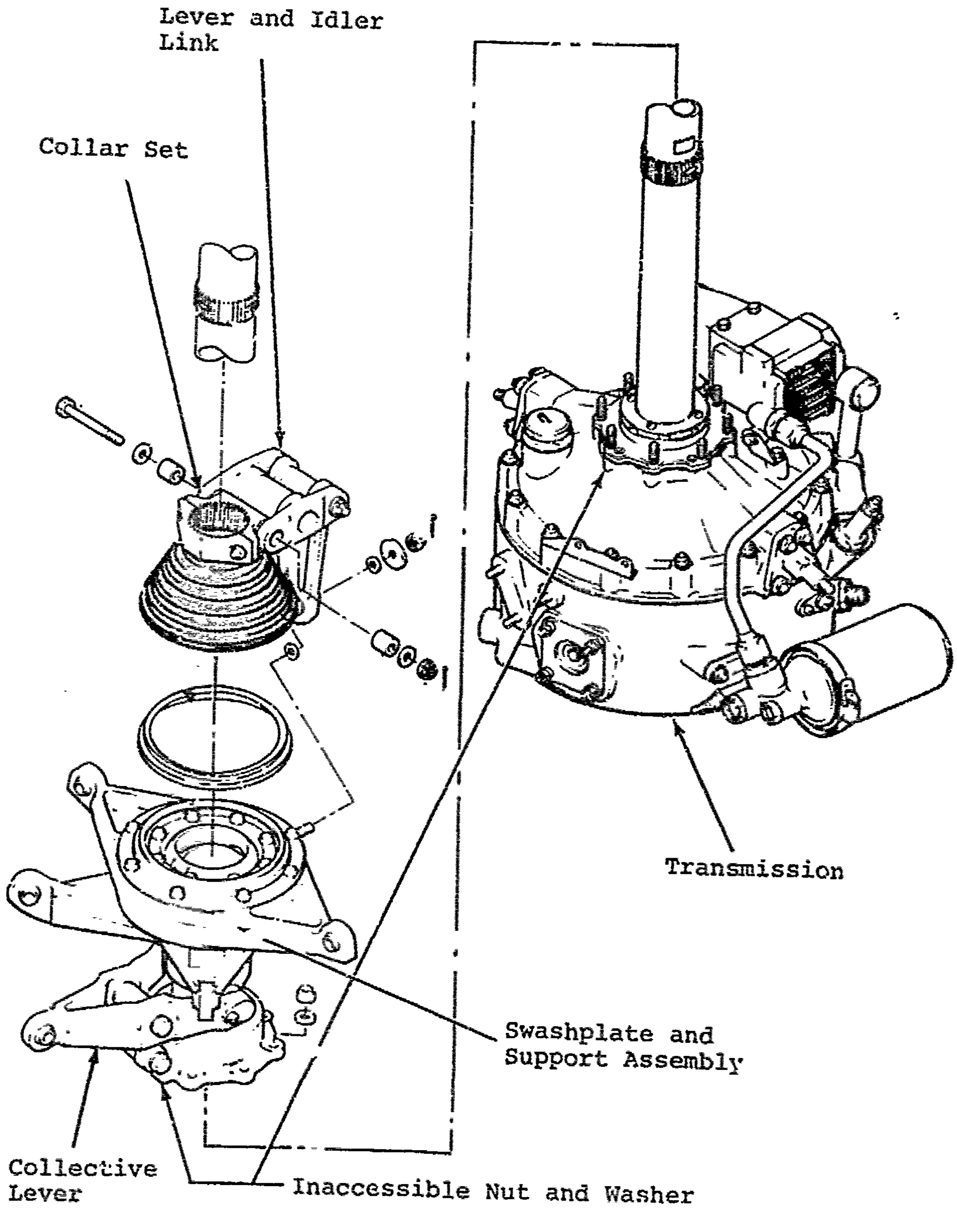


Figure 14. Swashplate and Transmission Assembly, OH-58 Helicopter.

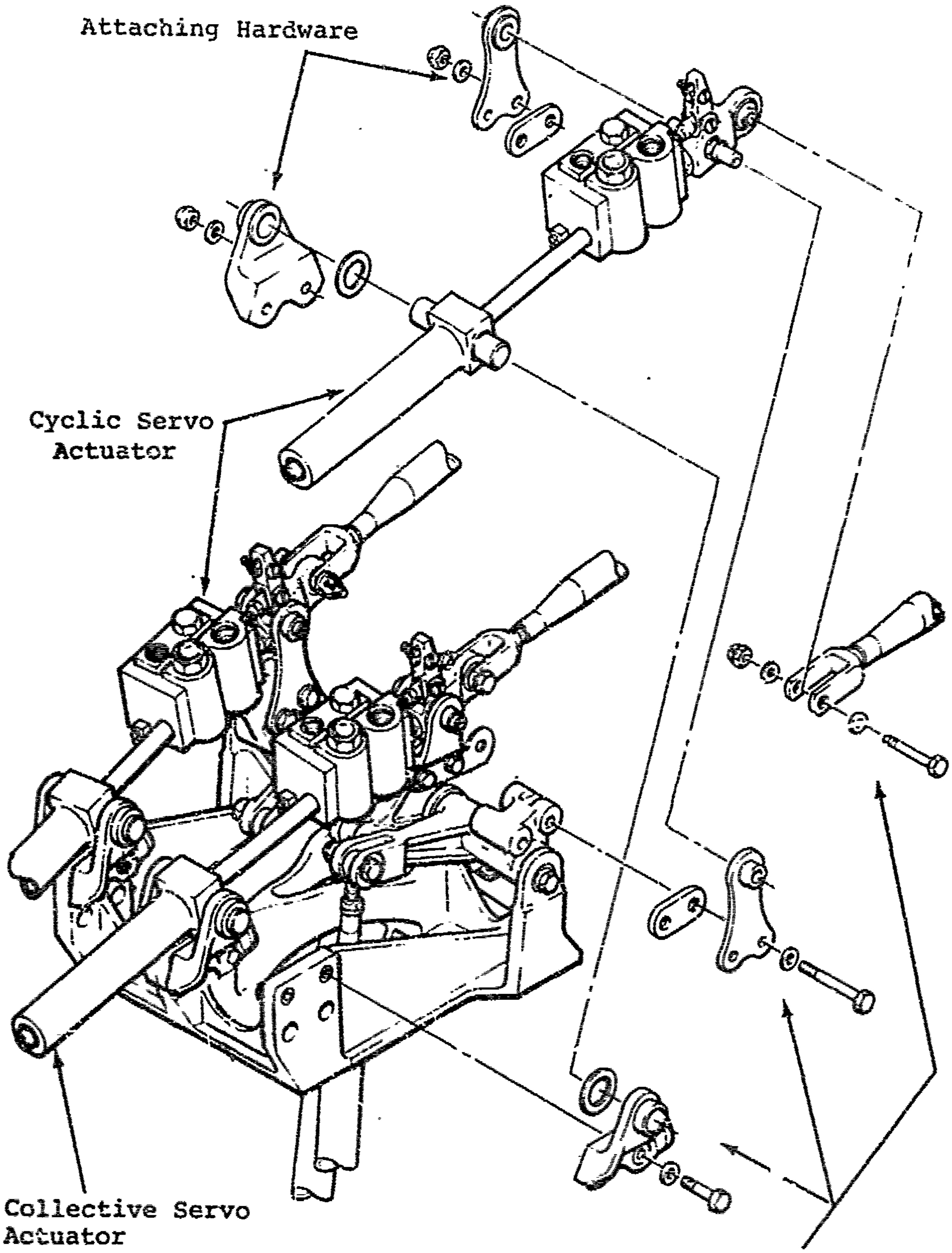


Figure 15. Cyclic and Collective Actuator Installation, OH-58 Helicopter.

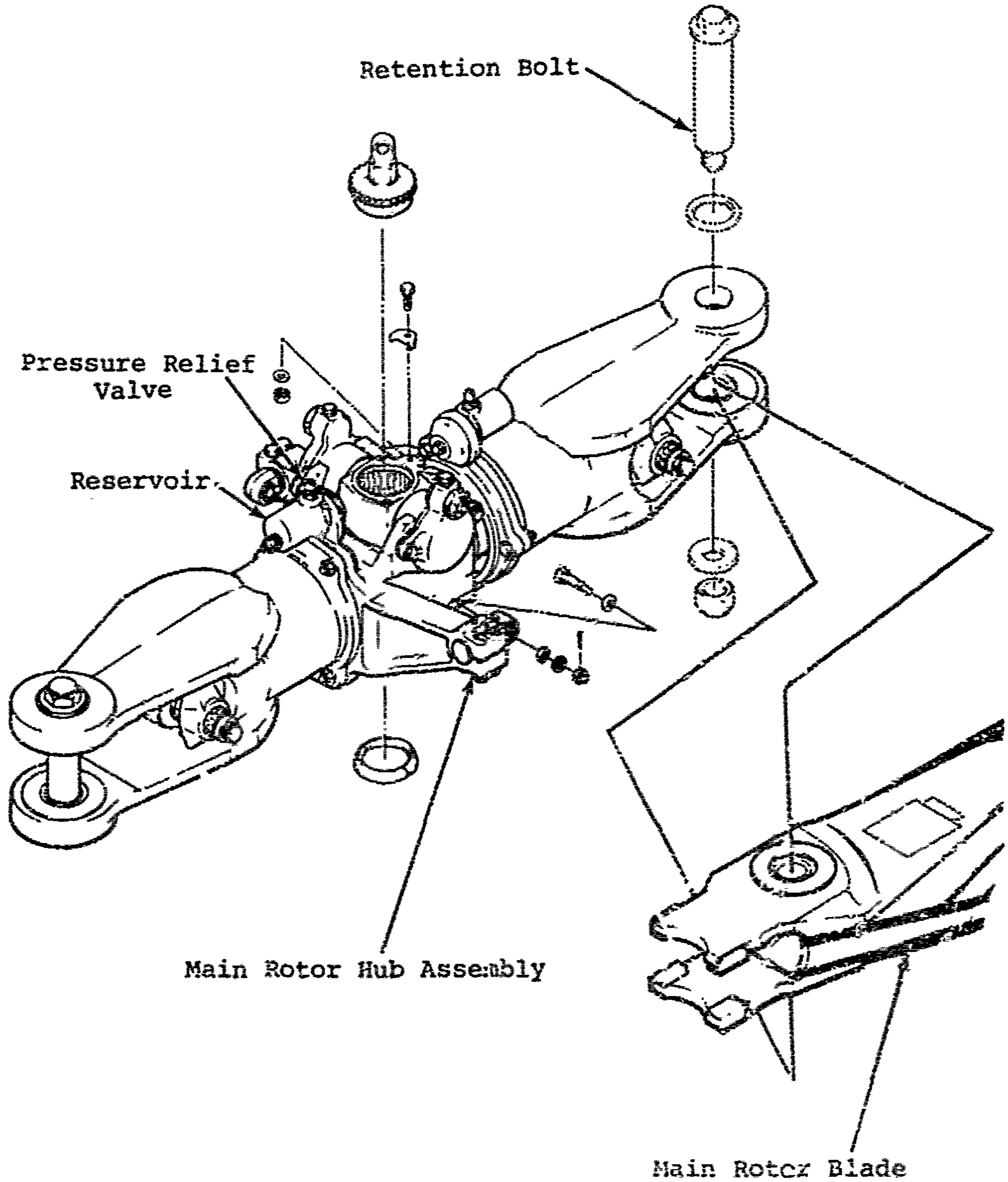


Figure 16. Main Rotor Hub and Blade Installation, OH-58 Helicopter.

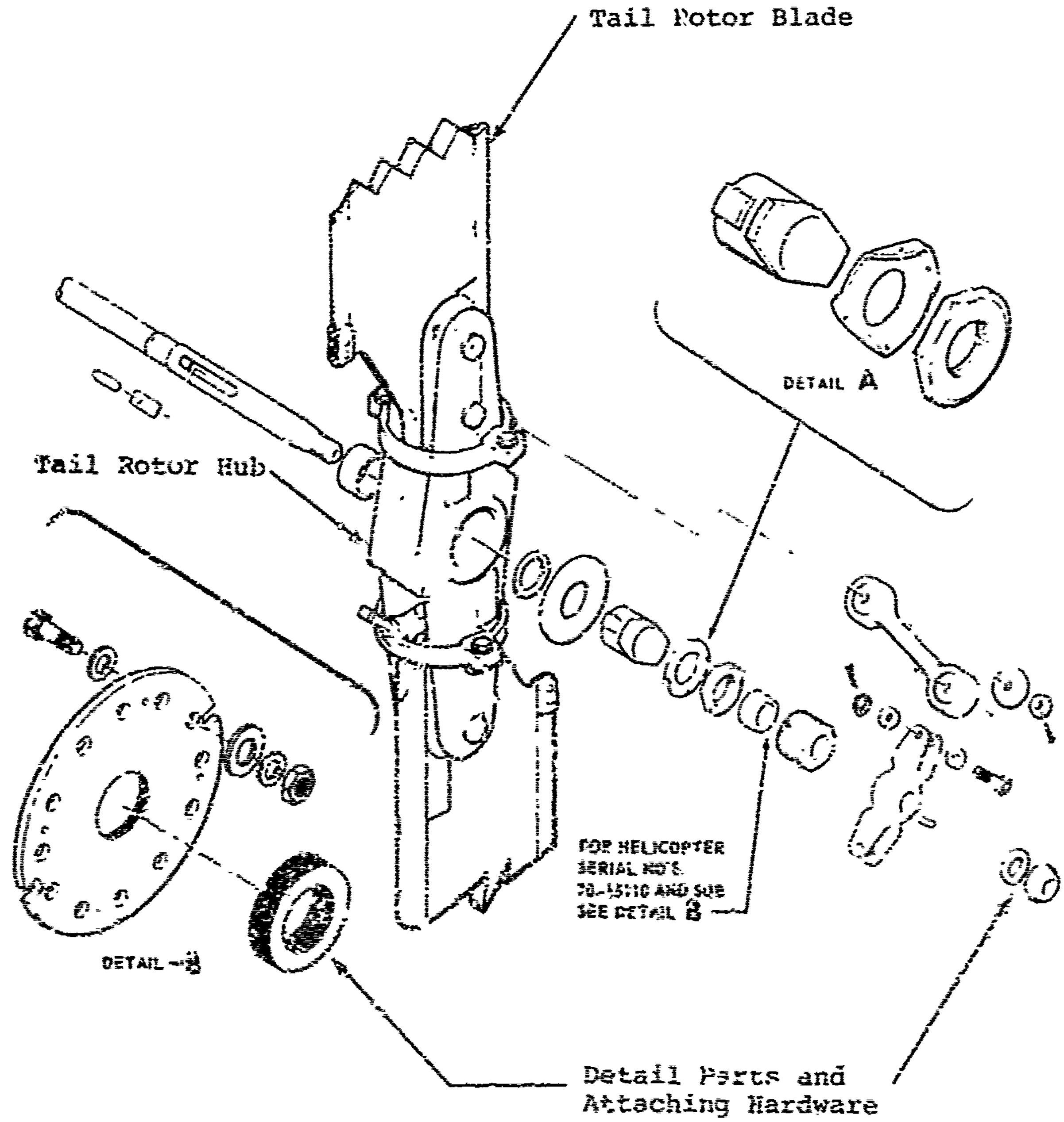


Figure 17. Tail Rotor Assembly, OH-58 Helicopter.

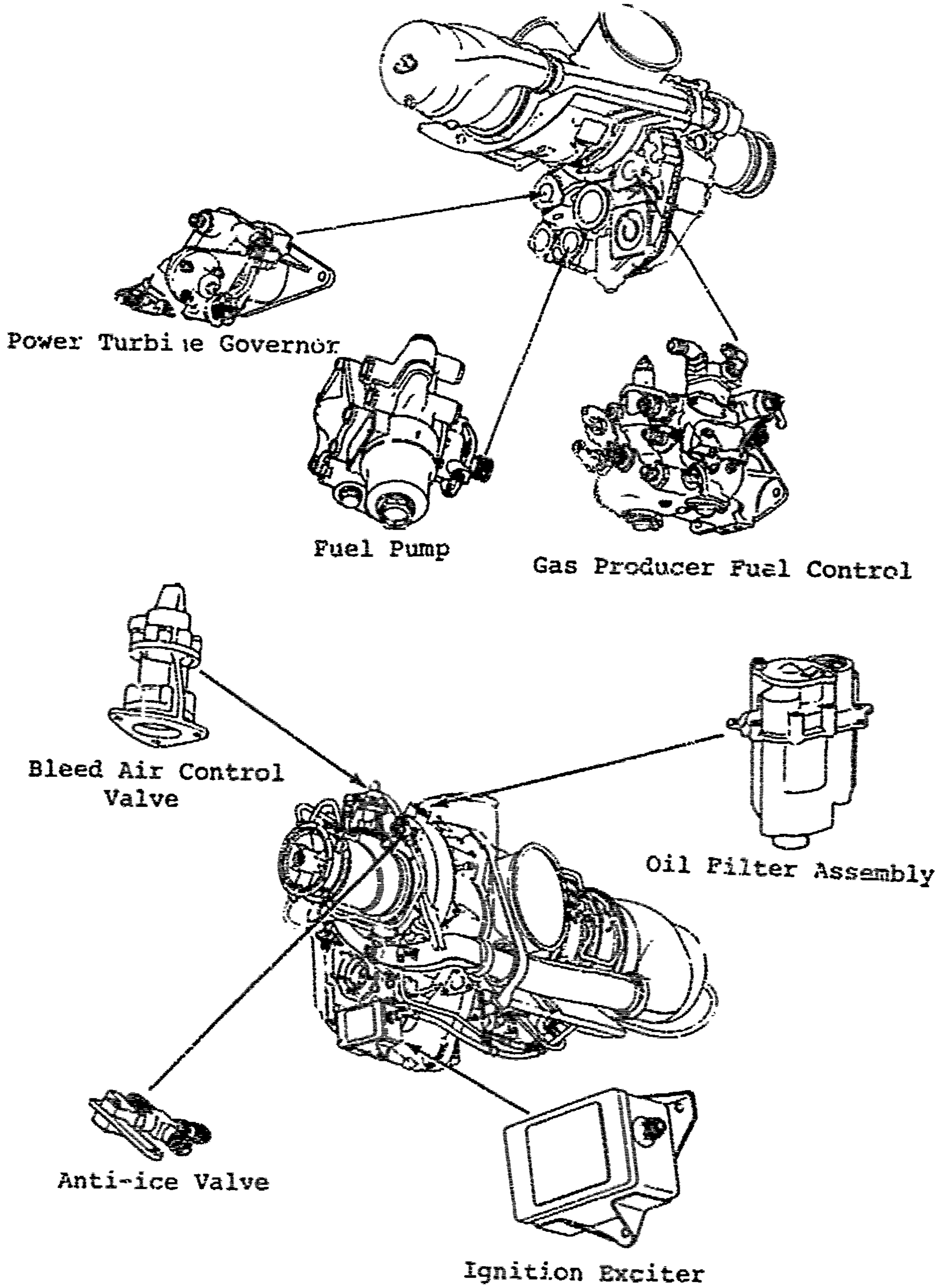


Figure 18. Engine Accessories, OH-58 Helicopter.

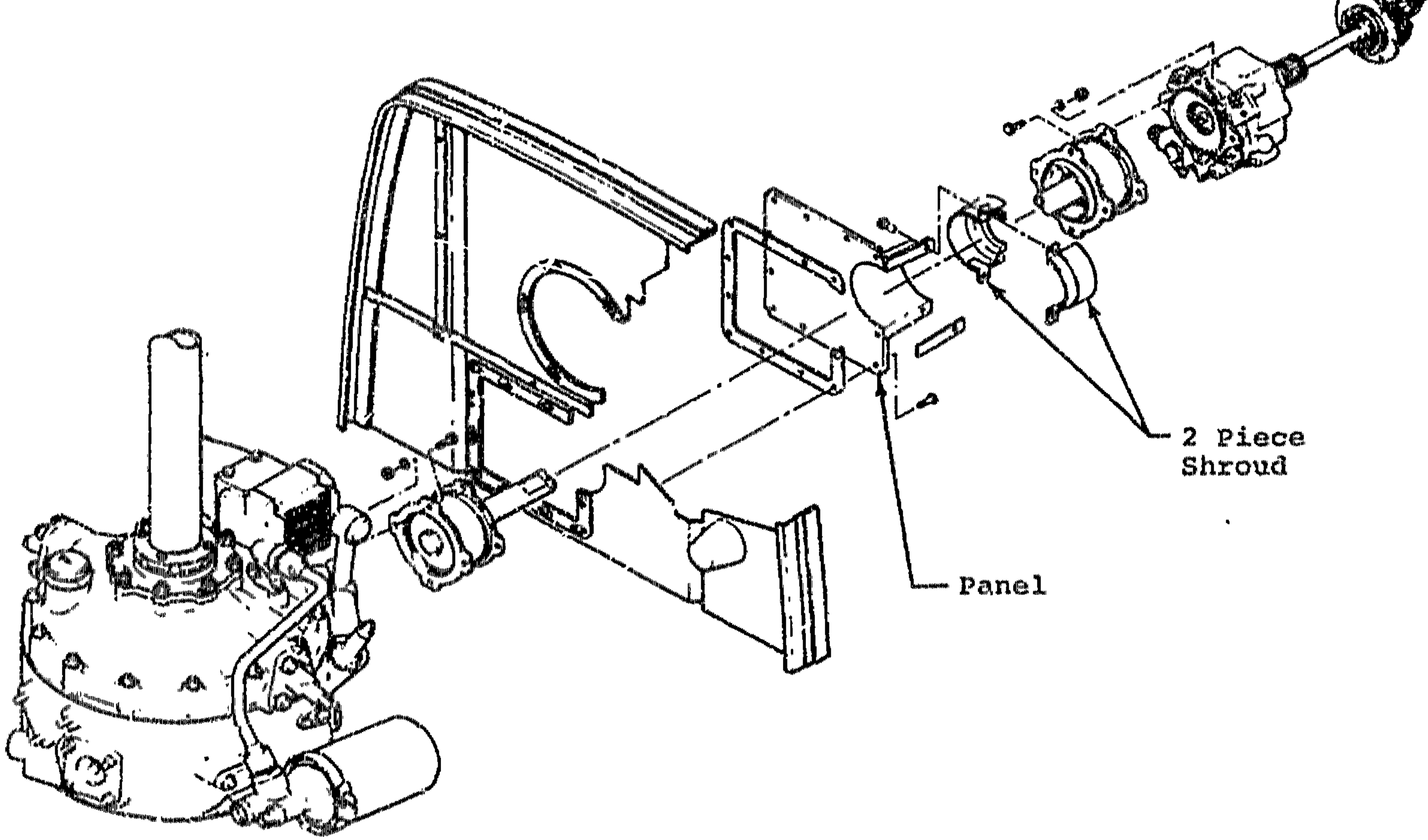


Figure 19. Drive Shaft Installation, OH-58 Helicopter.

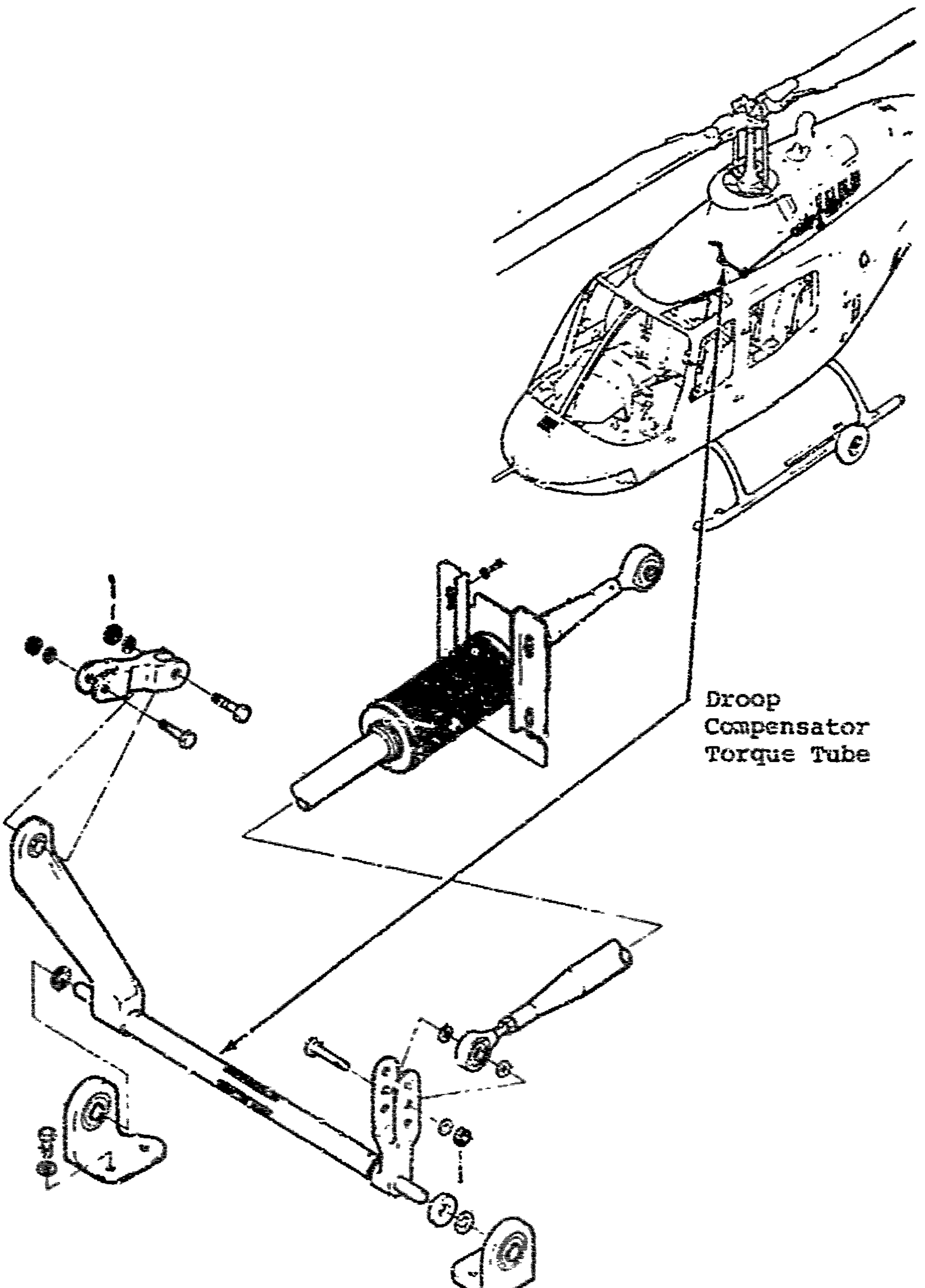


Figure 20. Droop Compensator Installation, OH-58 Helicopter.

SUMMARY OF DESIGN FACTORS RELATED TO MAJOR COMPONENT REPLACEMENTS, OH-58 HELICOPTER

The more significant maintainability design characteristics of the OH-58 helicopter, within the ten major component areas covered by the study, are in summary:

1. Tail Rotor System

   a. The tail rotor drive shaft is supported by six hanger bearings, all of which must be slipped onto the drive shaft from the forward end. This arrangement requires removal of all bearings located forward of the defective bearing being replaced.

   b. Changing the sequence of discs within the stackup or changing the orientation of any single disc renders the laminated steel disc flexible couplings unusable.

   c. Replacement of the tail rotor hub entails disconnecting, removing, installing and accounting for numerous parts and associated hardware.

   d. Procedures require removal of the tail rotor hub and blades as a unit in order to replace blades.

   e. Each hanger bearing has a self-aligning feature which requires a complicated bearing installation procedure.

   f. Disassembly and reassembly of the hardware are sometimes necessary to obtain proper shimming of the tail rotor hub.

2. Main Rotor Hub

   a. Frequently the main rotor blade retention it is difficult to remove.

   b. Overtorquing of bolts attaching reservoir, stat-o-seal, sight glass, and packings to the main rotor hub grips has caused cracked sight glasses and reservoir cases and deformed seals.

3. Transmissions and Gearboxes

   a. Due to physical location of components in the power delivery train to rotors, many drive, control, and

rotor components must be removed to provide access to the main transmission.

b. Replacement of the tail rotor gearbox requires removal of the tail rotor hub and blade assembly.

c. Spillage of oil is inevitable and much cleanup time is required when draining the transmission sump.

4. Hydraulic Servo Actuators

Numerous pieces of attaching hardware are required for mounting the actuators.

5. Starter Generator

a. Five electrical leads must be disconnected and reconnected when replacing the component.

b. The starter-generator must be properly supported whenever the attaching clamp is loosened or until the clamp has been installed and properly torqued.

6. Swashplate and Supporting Assembly

The nature of the design and its inherent function and location require removal and installation of a number of other components for replacement of this assembly.

7. Main Drive Shafts

a. On those helicopters equipped with armor plating, the plating must be removed to provide access to the engine-to-transmission drive shaft.

b. Screws attaching the metal shroud covering the drive shaft are inaccessible and frequently are stripped in the process of removal.

8. Power Plant Installation

a. The buildup of replacement engines includes removal of accessories from the old engine for installation on the replacement engine. This engine teardown and buildup process is time-consuming.

b. Accessories require removal of fittings from old assembly for buildup of the replacement assembly.

c. Two sizes of coupling nuts connect lines to the fuel pump. Each size has a specific torque valve.

d. The uppermost self-locking nut, attaching the fuel control to gearbox housing is difficult to remove and replace.

e. Three different torque valves are specified for installation of the governor.

f. Oil cooler replacement requires removing and replacing thirteen bolts and washers attaching the cooler to the duct extension.

TABLE XII. COMPONENT REPLACEMENT DATA, OH-6 HELICOPTER

Component Code and Nomenclature		Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
14032 Main Rotor Swashplate	Man-Hr	7.2	0.6		5.2		0.8		0.3	0.3
	Percent		8.3		72.2		11.1		4.2	4.2
	Note				(1)					
15003 Tail Rotor Hub Assembly	Man-Hr	3.2	0.5		0.3		0.9		1.0	0.5
	Percent		15.6		9.4		28.1		31.3	15.6
	Note								(2)	

(1) The design requires sequential removal and installation of a number of other components to effect replacement of this assembly. These components consist of: main rotor blades, drive shaft, scissors assembly and main rotor hub. Additional tasks include disconnecting and connecting the mixer, longitudinal, and pitch change links for the replacement process. These functions are time-consuming and require skilled personnel and special tools. (Figure 11).

(2) Replacement of the assembly usually requires rigging the tail rotor control system. This process consists of approximately sixteen steps, which include: gaining access to bellcranks, disconnecting attaching hardware, installing clamping blocks, using rigging tool (special tool), checking for angular throw and proper thread engagement and making adjustments. The rigging sequence is time-consuming due to number of steps involved.

TABLE XII - Continued

Component Code and Nomenclature			Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/Install Other Components	Remove/Install Buildup Items	Remove/Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
15010	Main Rotor Hub Assembly	Man-Hr	8.3	0.8		4.7		2.1	0.1	0.3	0.3
		Percent		9.6		56.6		25.3	1.2	3.6	3.6
		Note				(1)		(2)			
15047	Main Rotor Damper Assembly	Man-Hr	1.2	0.3				0.6			0.3
		Percent		25.0				50.0			25.0
		Note						(3)			

(1) Replacement of the main rotor hub requires removal and installation of the main rotor blades and drive shaft. Disconnecting and connecting linkages on the scissors assembly and pitch change rods is also required. A large portion of the hub replacement time is attributed to these tasks. When removing the main rotor drive shaft, the four eyebolts which partially secure the shaft to the hub must be pulled and then reinstalled in the hub for attachment of the lifting adapter. This task also adds to replacement time (Figure 21).

(2) Hub replacement involves the use of a number of special tools. Installation and use of these tools contributes to the maintenance time required. (Figure 22).

(3) Two different bolts (NAS464P-14 or 369A1020) are used to attach the damper arm, depending upon the configuration. When bolt 369A1020 is used, shimming is required to provide clearance between the bolt end and damper housing.

TABLE XII - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
15153	Tail Rotor Blade	Man-Hr	3.8	0.4		1.8		0.3		1.0	0.3
		Percent		10.5		47.4		7.9		26.3	7.9
		Note				(1)				(1,2)	
22007	Engine	Man-Hr	14.5	0.7	0.1	3.1	4.0	5.2	0.3	0.5	0.6
		Percent		4.8	0.7	21.4	27.6	35.9	2.1	3.4	4.1
		Note				(3)	(4)	(5,6)			

(1) Phenolic spacers of two sizes are used to maintain clearance between the blade tip and tail boom. Replacement of the tail rotor blade and hub requires three judgment measurements by maintenance personnel: spacer size selection, application of required pressure to the blade tip and measuring clearance between the blade tip and boom.

(2) Replacement of the blade normally requires checking and adjusting rigging of the tail rotor control system. Rigging is a time-consuming process, involving many steps.

(3) Little or no clearance exists between the engine input and output oil line fittings. This arrangement restricts adequate wrench bites and contributes to the difficulty in disconnecting and connecting the lines.

(4) Special mounting pads are required to attach the engine to the shop stand for buildup and tear-down.

(5) When detaching the side engine mounts, the attaching bolts must be backed-out evenly to prevent disengaging one side before the other, consequently dropping that side and causing damage to fittings and hardware.

(6) Safety wiring the lower engine mount is difficult due to limited working area.

TABLE XII - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust/ Align Track Etc.	Inspect And Test
22044	Power Turbine Governor	Man-Hr	3.5	0.8	0.1		0.4	1.8	0.1		0.3
		Percent		22.9	2.9		11.4	51.4	2.9		8.6
		Note						(1)			
22054	Gas Producer Fuel Control	Man-Hr	3.6	0.8	0.1		0.5	1.6	0.1	0.2	0.3
		Percent		22.2	2.8		13.9	44.4	2.8	5.6	8.3
		Note						(2)			
22062	Oil Cooler	Man-Hr	5.1	0.3	0.8	1.5		1.8	0.4		0.3
		Percent		5.9	15.7	29.4		35.3	7.8		5.9
		Note			(3)	(3,4)					

(1) The most difficult and time-consuming task involved for component replacement is removing and installing two of the three nuts and washers that secure the governor to the gearbox housing. Access to these attachment points is limited due to the proximity of adjacent line (tube) runs and the engine gearbox housing. In addition, installation of the component includes application of three different torque values. (Figure 23).

(2) A large portion of the component replacement time and effort is attributed to restricted access to the top mounting stud and hardware which secures the fuel control to the gearbox housing. The access area does not permit clearance for proper tool application and freedom of movement. (Figure 23)

(3) Oil cooler replacement requires removal of the oil cooler duct. Access to attaching hardware requires removal of the right side troop seat, sound-proofing installation and oil cooler access door in the aft cabin compartment.

(4) Inaccessible bolts and nuts with separable spacers contribute to the difficulty of detaching the duct at the oil cooler interface.

TABLE XII - Continued

Component Code and Nomenclature			Task Element								
			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22110	Engine Oil Filter	Man-Hr	0.7	0.2	0.1			0.3			0.1
		Percent		28.6	14.3			42.9			14.3
26012	Main Transmission	Man-Hr	15.6	0.5	2.0	6.0	0.4	3.3	1.1	0.6	1.7
		Percent		3.2	12.8	38.5	2.6	21.2	7.1	3.8	10.9
		Note				(1,2)					
26017	Tail Rotor Gearbox	Man-Hr	6.7	0.4	0.3	2.5	0.3	1.0	0.4	1.7	0.1
		Percent		6.0	4.5	37.3	4.5	14.9	6.0	25.4	1.5
		Note				(3)					

(1) The tail rotor gearbox and tail rotor drive shaft must be disconnected and moved aft about 1 foot to allow removal of the transmission. Access to the forward tail rotor drive shaft coupling is limited and a 2 foot-long socket wrench extension is used to reach the coupling's 3 attach bolts.

(2) Some aviation companies elect to remove the main rotor drive shaft during a transmission change to facilitate proper engagement of mating drive splines upon reinstallation of transmission. The main rotor drive shaft attaches to the main rotor hub via 8 nuts and bolts. The nuts are in close proximity to hub webs and flanges. A special torque wrench adapter has been provisioned, but it frequently strips in use. (Figure 24).

(3) Replacement of the tail rotor gearbox requires removal and reinstallation of the tail rotor. Upon reinstallation, balance and track is checked.

TABLE XII - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26019	Main Drive Shaft	Man-Hr	2.4	0.3	1.2			0.5		0.4	
		Percent		12.5	50.0			20.8		16.7	
		Note			(1)			(2)		(3)	
26023	Tail Rotor Drive Shaft	Man-Hr	3.7	0.2	0.3	0.3	0.3	0.8		1.7	0.1
		Percent		5.4	8.1	8.1	8.1	21.6		45.9	2.7
		Note								(4,5)	

(1) Sound insulation and main transmission access door must be removed and reinstalled.

(2) The lower set of 3 shaft attach bolts are in close proximity with surrounding sheet metal structure. More clearance is desirable to facilitate use of torque wrench on bolts.

(3) Shimming must be accomplished so that the main drive shaft fits between the clutch output flange and the transmission input flange with no more than .020 inch compression nor any more than .010 inch gap. The shimming procedure is similar to the one used for the tail rotor drive shaft shown in Figure 25.

(4) Shimming must be accomplished so that the tail rotor drive shaft fits between the transmission output coupling and the tail rotor gearbox input coupling with .000 to .005 inch compression of the two flexible diaphragm couplings. (Figure 25).

(5) The shimming procedure requires that the shaft and tail rotor gearbox be installed, gap measurements taken, shaft and gearbox removed, shims installed and, finally, the shaft and gearbox reinstalled.

TABLE XII - Continued

Component Code and Nomenclature			Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/Install Other Compon-ents	Remove/Install Buildup Items	Remove/Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26126	Bearing Seal-Tail Rotor Gearbox	Man-Hr	3.7	0.3		2.1		0.6	0.3		0.5
		Percent		5.4		56.7		16.2	8.1		13.5
		Note				(1)					
26187	Oil Filter-Main Transmission	Man-Hr	1.0	0.3	0.3			0.3			0.1
		Percent		30.0	30.0			30.0			10.0
		Note			(2)			(3)			
42055	Starter Generator	Man-Hr	1.2	0.3	0.1			0.5			0.3
		Percent		25.0	8.3			41.7			25.0
		Note						(4)			

(1) Replacement of the tail rotor gearbox output seal requires removal and reinstallation of the tail rotor. Upon reinstallation, balance and track is checked.

(2) Sound insulation and 2 access covers must be removed to expose the filter through the aft cabin ceiling.

(3) Safety wiring is difficult because the anchor hole for the lock wire is through a boss on the aft side of the pump housing which is relatively inaccessible. The lock wire must be started through the anchor hole before the filter housing is screwed into the pump housing.

(4) Replacement includes disconnecting and connecting individual leads to the starter generator. These leads must be identified upon removal to ensure proper installation.

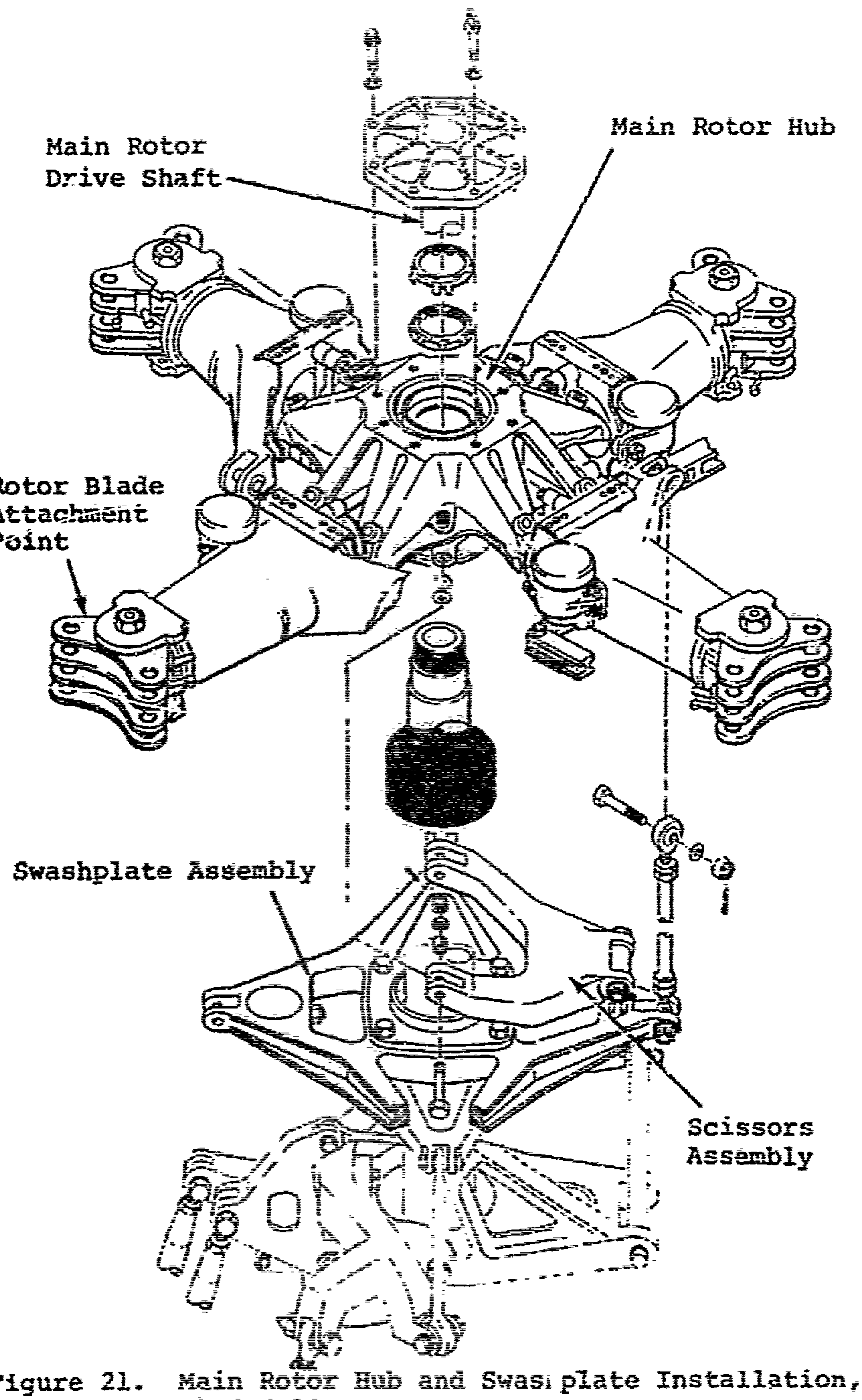


Figure 21. Main Rotor Hub and Swashplate Installation, OH-6 Helicopter.

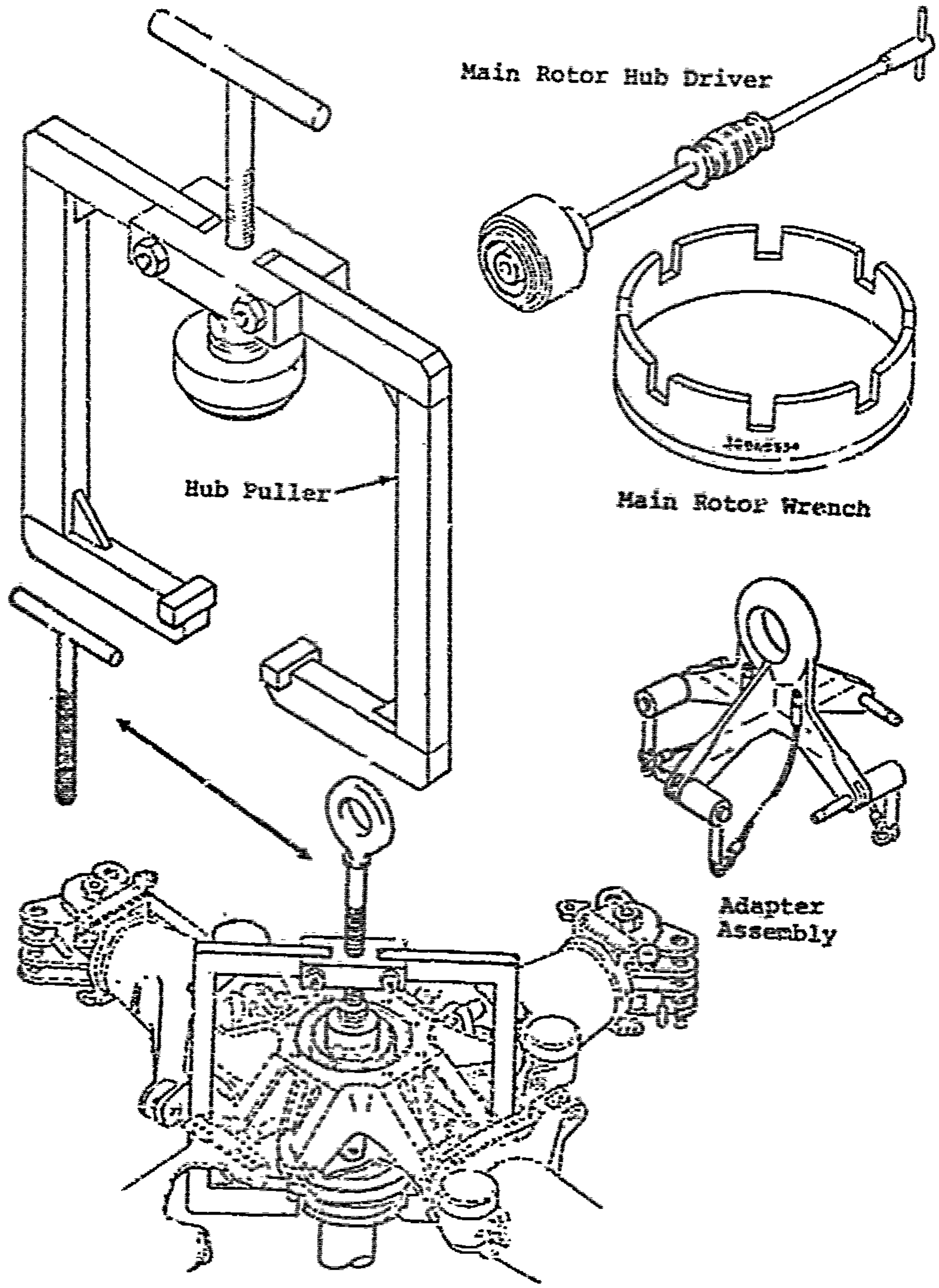


Figure 22. Special Tools for Main Rotor Hub Replacement, OH-6 Helicopter.

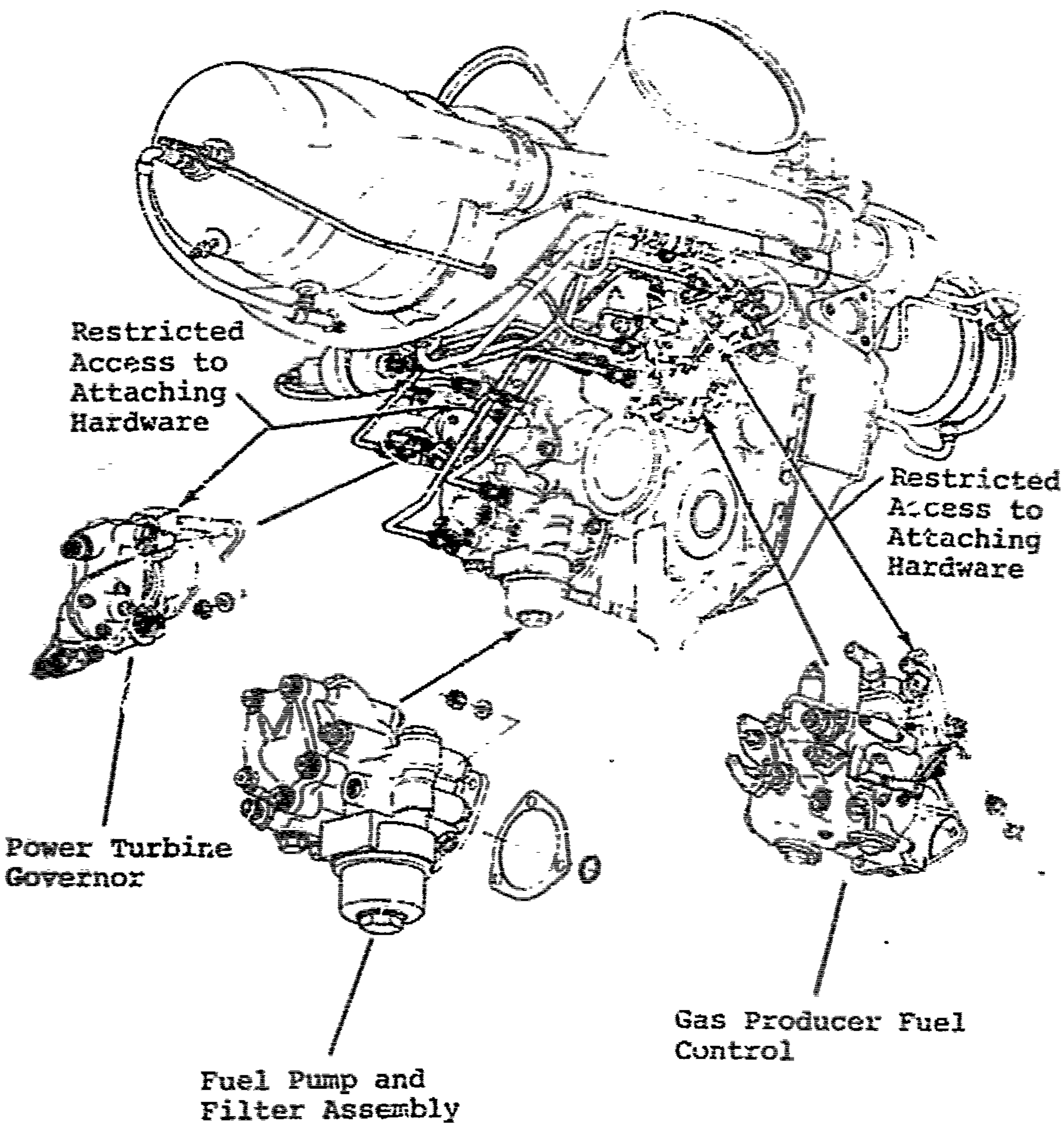


Figure 23. Engine Fuel System Components Installation, OH-6 Helicopter.

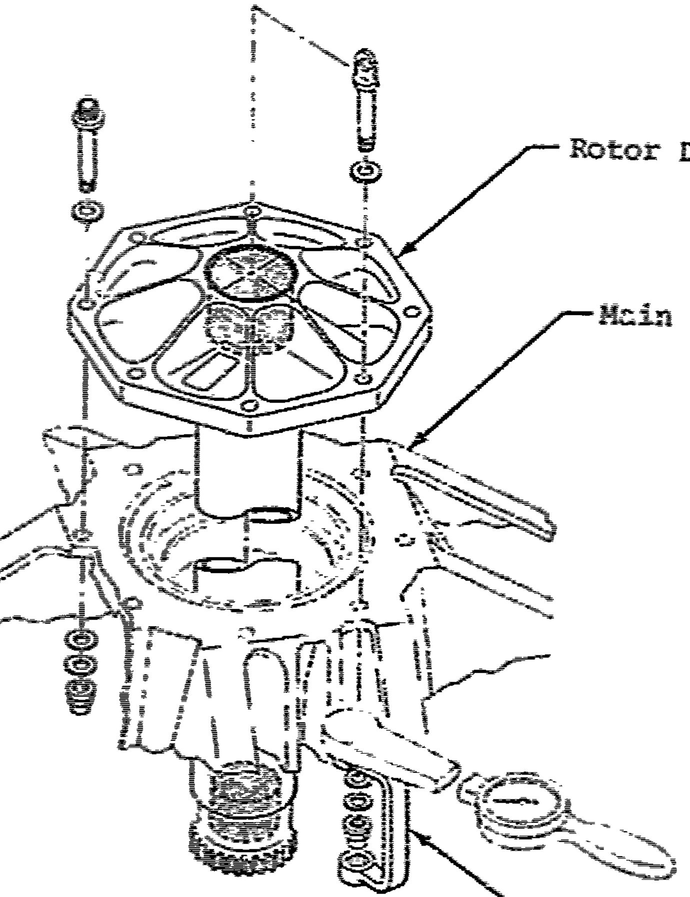
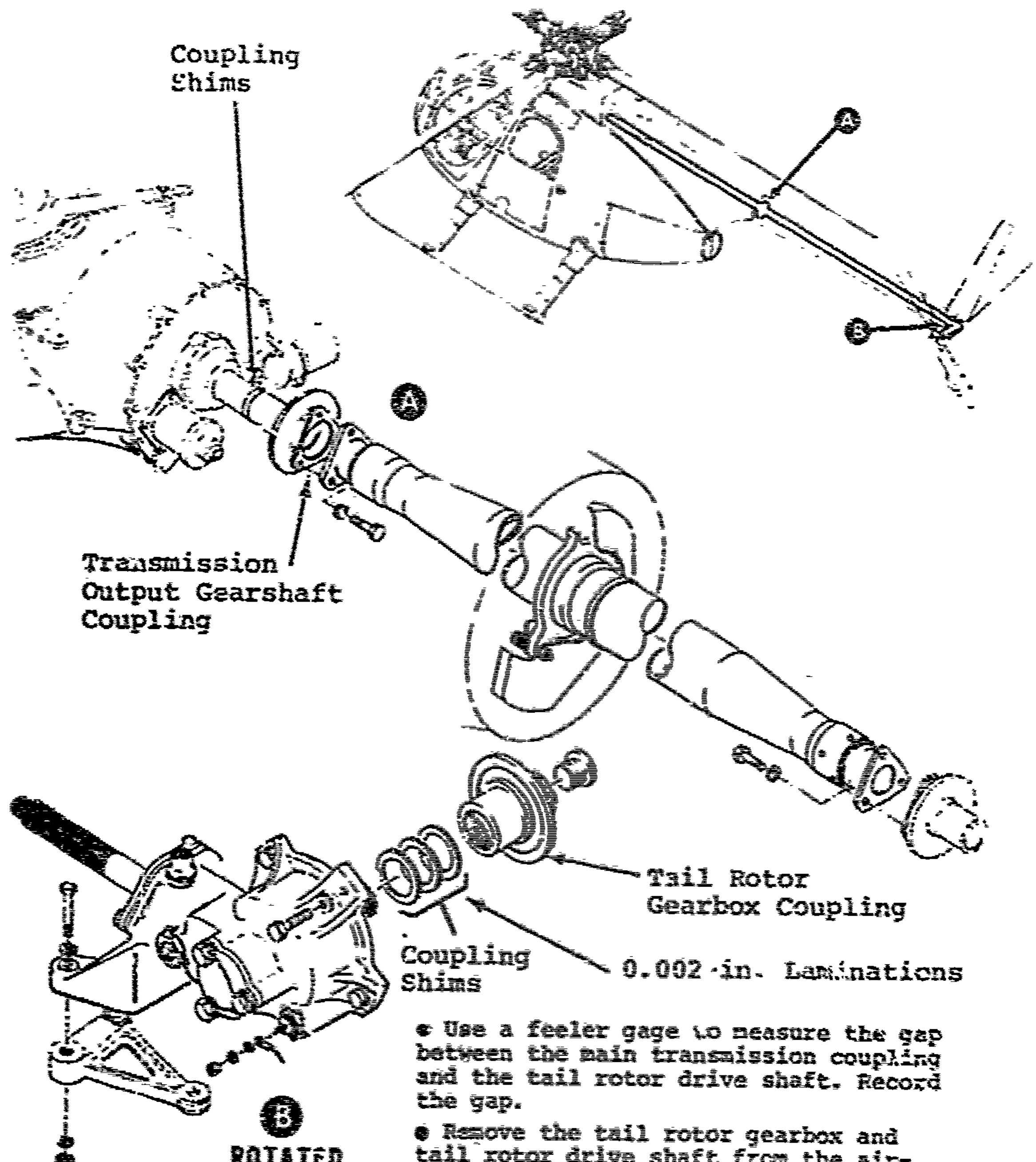


Figure 24. Rotor Drive Shaft-to-Hub Attachment, OH-6 Helicopter.



- Use a feeler gage to measure the gap between the main transmission coupling and the tail rotor drive shaft. Record the gap.
- Remove the tail rotor gearbox and tail rotor drive shaft from the aircraft.
- Select a shim thickness to fill the measured gap. No gap (coupling tension) is allowable but there may be up to 0.005-inch coupling compression.
- Divide shims equally between the main transmission and tail rotor gearbox couplings. Install required shims, and torque coupling bolts to 100-150 inch-pounds.

Figure 25. Flexible Diaphragm-Type Coupling Shimming, OH-6 Helicopter.

SUMMARY OF DESIGN FACTORS RELATED TO MAJOR COMPONENT REPLACEMENT, OH-6 HELICOPTER

The more significant maintainability design characteristics of the OH-6 helicopter, within the ten major component areas covered by the study, are in summary:

1. Tail Rotor System

   a. Replacement of the tail rotor hub assembly usually requires rigging the tail rotor control system. The rigging sequence is time-consuming due to the number of steps involved.

   b. Replacement of the tail rotor blade and hub requires three judgement measurements by maintenance personnel.

   c. Replacement of the tail rotor gearbox requires removal and reinstallation of the tail rotor. Upon reinstallation, balance and track must be checked.

   d. Shimming must be accomplished so that the tail rotor drive shaft fits between the transmission output coupling and the tail rotor gearbox input coupling. The shimming procedure requires that the shaft and tail rotor gearbox be installed, gap measurements taken, shaft and gearbox removed, shims installed and, finally, the shaft and gearbox reinstalled.

2. Main Rotor Hub

   a. Replacement of the main rotor hub requires removal and installation of the main rotor blades and drive shaft. Disconnecting and connecting linkages on the scissors assembly and pitch change rods is also required. A large portion of the hub replacement time is attributed to these tasks.

   b. Hub replacement involves the use of a number of special tools.

   c. Two different bolts (NAS464P-14 or 369A1020) are used to attach the main rotor damper arm depending upon the configuration. When bolt 369A1020 is used, shimming is required to provide clearance between the bolt end and damper housing.

3. Transmissions and Gearboxes

   a. The tail rotor gearbox and tail rotor drive shaft must be disconnected and moved aft about a foot to allow removal of the transmission. Access to the forward tail rotor drive shaft coupling is limited.

   b. Sound insulation and two access covers must be removed to expose the main transmission oil filter.

   c. Safety wiring the main transmission oil filter is difficult.

4. Starter Generator

   a. Replacement includes disconnecting and connecting electrical leads. These leads must be identified upon removal to insure proper installation.

5. Swashplate and Supporting Assembly

   a. The design requires sequential removal and installation of a number of other components to effect replacement of the assembly.

6. Main Drive Shaft

   a. Sound insulation and main transmission access doors must be removed and reinstalled for replacement of the drive shaft.

   b. The lower set of attachment bolts is in close proximity to surrounding sheet metal. More clearance is desirable to facilitate use of a torque wrench on the bolt.

   c. Shimming must be accomplished so that the main drive shaft fits between the clutch output flange and the transmission input flange with no more than .020 inch compression nor any more than .010 inch gap.

7. Power Plant Installation

   a. Little or no clearance exists between the engine input and output oil line fittings. The arrangement restricts adequate wrench bites and contributes to the difficulty of disconnecting and connecting the lines.

b. Special mounting pads are required to attach the engine to the shop stand for buildup and teardown.

c. Safety wiring the lower engine mount is difficult due to limited working area.

TABLE XIII. COMPONENT REPLACEMENT DATA, UH-1 HELICOPTER

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
14118	Collective Lever Assembly	Man-Hr	2.1	0.4				1.0		0.5	0.2
		Percent		19.0				47.6		23.8	9.5
		Note						(1)			
1412B	Swashplate/ Support Assembly	Man-Hr	10.0	0.8		5.0		2.2	0.2	1.0	0.8
		Percent		8.0		50.0		22.0	2.0	10.0	8.0
		Note				(2,3)		(3)			

(1) The assembly consists of two collective lever halves attached to the collective idler bracket and pivoting about a bearing assembly and thrust washer on the collective sleeve. The collective lever assembly includes many detailed parts which must be disassembled and reassembled during the replacement process. (Figure 26).

(2) When replacing the swashplate and support assembly, a large portion of the total maintenance effort is devoted to the task of removing and installing other components. These components consist of: stabilizer bar with attaching control tubes, main rotor hub and blade assembly, stabilizer bar damper and adapters, and the scissors and sleeve assembly. (Figure 27).

(3) The design is such that component replacement involves disconnecting, connecting, removing, installing and accounting for numerous parts which become loose hardware, easily misplaced by maintenance personnel. (Figure 27).

TABLE XIII - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
				Task Element							
14141	Flight Control Cyl/Valve	Man-Hr	3.8	0.5	0.4		0.3	1.1	.3	0.5	0.7
		Percent		13.2	10.5		7.9	28.9	7.9	13.2	18.4
		Note						(1,2)			
15115	Main Rotor Hub Assembly	Man-Hr	11.1	0.8		3.6	1.5	2.0	0.2	2.0	1.0
		Percent		7.2		32.4	13.5	18.0	1.8	18.0	9.0
		Note				(3)		(3)			
1511D	Scissors/ Sleeve Assembly	Man-Hr	5.7	0.9		2.2		1.5	0.3	0.3	0.5
		Percent		15.8		38.6		26.3	5.3	5.3	8.8
		Note				(4)					

(1) When installing a replacement cylinder, the new cylinder must be adjusted to the same length as the removed cylinder. Occasionally, the removed cylinder is no longer available or is damaged such that the required measurement cannot be obtained. This necessitates rigging the flight control system, a time-consuming function.

(2) The system contains three cylinders (left cyclic, right cyclic and collective) which appear identical. Although they are not functionally interchargeable, without making certain adjustments, they can be physically interchanged. There have been occurrences of improper installation which necessitated removal and relocation of the cylinders into their correct position. (Figure 28).

(3) Many different torque values must be applied when installing the hub and associated hardware, with critical torques witnessed and/or verified by a technical inspector. Shimming is required to obtain proper clearance between the rotor blade and drag brace clevis. (Figure 29).

(4) When replacing the scissors and sleeve assembly, a large segment of the total maintenance effort is devoted to removing and installing other components. These components consist of: stabilizer bar, main rotor, and stabilizer dampers with adapters. (Figure 27).

TABLE XIII - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
15118	Main Rotor Counterweight	Man-Hr	1.4	0.5				0.6			0.3
		Percent		35.7				42.9			21.4
15211	Tail Rotor Hub Assembly	Man-Hr	3.5	0.3		1.0		0.8	0.1	0.8	0.5
		Percent		8.6		28.6		22.9	2.9	22.9	14.3
		Note				(1)				(2)	
15212	Tail Rotor Blade Assembly	Man-Hr	3.7	0.3		0.6		1.4	0.1	0.8	0.5
		Percent		8.1		16.2			2.7	21.6	13.5
22200	T-53 Engine	Man-Hr	42.2	1.0	1.5	2.2	24.0	[illegible]		2.0	2.0
		Percent		2.4	3.6	5.2	56.9	22.5		4.7	4.7
		Note					(3)				

(1) The tail rotor hub and blade installation contains many small parts and items of hardware, the handling of which contributes significantly to the total maintenance time. (Figure 30).

(2) During installation of the tail rotor hub, the crosshead is temporarily assembled in order to measure the gap between the retainer plate and crosshead for shimming. The process of buildup teardown, and final buildup is time-consuming. (Figure 30).

(3) Teardown and buildup of engine accessories represents the largest single element of the replacement task. Many steps, involving disassembly and reassembly of items in prescribed sequence, are involved in the engine buildup process. (Figures 31 and 32).

TABLE XIII - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
22261	Fuel Regulator	Man-Hr	7.8	1.0	0.2	1.4	0.3	3.3	0.3	0.8	0.5
		Percent		12.8	2.6	17.9	3.8	42.3	3.8	10.3	6.4
		Note						(1)			
22262	Main Fuel Manifold	Man-Hr	5.5	0.8	0.5			3.3	0.5		0.4
		Percent		14.5	9.1			60.0	9.1		7.3
		Note						(2)			
22263	Starting Fuel Solenoid Valve	Man-Hr	2.5	0.5	0.3			1.4			0.3
		Percent		20.0	12.0			56.0			12.0
2226310	Starting Fuel Nozzle	Man-Hr	4.4	0.3	0.5			2.7	0.5		0.4
		Percent		6.8	11.4			61.4	11.4		9.1
		Note						(3)			

(1) Replacement involves disconnecting and connecting a number of fuel and air lines, electrical cables and mechanical linkage. Sequential steps must be followed to properly locate line runs and make the proper connections.

(2) The main fuel manifold is bracketed to the starting fuel manifold and mounted at the rear of the engine combustion chamber housing. Replacement tasks in lower sections of the manifold, adjacent to the fire-wall structure, are hindered because of the congested area and limited space available for tool application.

(3) Two engine starting fuel nozzels are located at the 4 and 8 o'clock positions in the rear of the combustion chamber housing. The adjacent fire-wall structure limits the available working area for on-aircraft component replacement.

TABLE XIII - Continued

Component Code and Nomenclature			Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22291	Exciter Unit	Man-Hr	1.9	0.5	.0.3			0.9			0.2
		Percent		26.3	15.8			47.4			10.5
22293	Igniter Plug	Man-Hr	1.8	0.5	0.3			0.7			0.3
		Percent		27.8	16.7			38.9			16.7
		Note						(1)			
26111	Main Drive Shaft	Man-Hr	3.5	0.3	0.3	0.3		0.7	1.1		0.8
		Percent		8.6	8.6	8.6		20.0	31.4		22.9
		Note							(2)		(3)

(1) The engine contains four igniter plugs installed in receptacles in the aft end of the combustion chamber at 2, 4, 8, and 10 o'clock positions. The plugs located at the 4 and 8 o'clock positions are the most difficult to replace with the engine installed because of their proximity to the fire wall structure.

(2) The quantity of grease packed in couplings is critical. The packing procedure demands precision and is time-consuming. Replacement couplings are not prepacked. (Figure 33).

(3) Inspection requires disassembly of shaft and complete removal of old grease. Solvents may not be used. Some maintenance companies use cotton-tipped sticks (Q-Tips) for this task. Each spline tooth is individually cleaned and visually inspected for unacceptable wear patterns and/or deterioration.

TABLE XIII - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26211	Main Transmission	Man-Hr	31.4	1.0	2.4	8.1	4.0	10.1	0.8	2.4	2.6
		Percent		3.2	7.6	25.8	12.7	32.2	2.5	7.6	8.3
		Note				(1)		(2)	(3)		
2621C	Mast Assembly	Man-Hr	10.3	0.5	0.8	3.9		4.1			1.0
		Percent		4.9	7.8	37.9		39.8			9.7
		Note				(4)					(5)

(1) Due to the arrangement (physical location) of components in the power delivery train to the rotors, many components must be removed to provide access to the transmission. These include main rotor blades, main rotor hub, stabilizer bar assy., swashplate and support assy., control rods, and drive shafts.

(2) Access to lines, hoses, transmission mounts, lift link, drive shaft couplings, etc., is gained through access panels on both sides of pylon island structure and through a "hell hole" in lower fuselage under the pylon. Removal of panels is not difficult, but the resultant openings do not provide easy access to the listed components.

(3) Transmission is drained very easily by opening drain valve and allowing oil to flow through drain line overboard under the helicopter. However, if the aircraft has been operated in a dusty environment, the residual film of oil in the drain line continues to collect dust until the line becomes completely blocked. Disassembly of lines and fittings is then necessary for cleaning.

(4) Due to the location of the mast assembly in the power delivery train to the main rotor, its removal requires the prior removal of the main rotor blades, main rotor hub, stabilizer bar assy., and swashplate and support assy.

(5) Occasionally, precautionary mast replacements are made for lack of a good method of checking depth of scratches. The maximum permissible depth of repairable scratch is .010 inch.

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
2621E	Main Input Quill (Main Transmission)	Man-Hr	7.3	0.5	0.8	1.6		4.0			[illegible]
		Percent		6.8	11.0	21.9		54.8			5.[illegible]
		Note						(1,2,3)			
2621J	Tubing-Main Transmission	Man-Hr	1.3	0.3	0.5			0.5			
		Percent		23.1	38.5			38.5			
2621K	Hose-Main Transmission	Man-Hr	1.7	0.3	0.5			0.9			
		Percent		17.6	29.4			52.9			

TABLE XIII - Continued

(1) Removal of quill requires use of special jack screws and may also require application of heat to transmission case.

(2) During installation of the quill, a rubber plug is temporarily positioned in the roller input bearing to hold the rollers against their outer race, thereby permitting insertion of inner race which is part of quill assy. The rubber plug must be inserted in the roller bearing from inside the transmission. This is accomplished through an unused mounting port on the left-hand side of the transmission.

(3) Installation of quill requires application of heat to transmission case.

TABLE XIII - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
26411	Tail Rotor Drive Shaft	Man-Hr	1.7	0.2	0.6			0.9			
		Percent		11.6	35.3			52.9			
		Note						(1,2)			
26413	Tail Rotor Shaft Hanger	Man-Hr	2.0	0.3	0.1	1.3		0.3			
		Percent		15.0	5.0	65.0		15.0			
		Note				(3)					
26414	Intermediate Gearbox	Man-Hr	3.1	0.4	0.4	0.8		0.8	0.4		0.3
		Percent		12.9	12.9	25.8		25.8	12.9		9.7
		Note						(4)			

(1) Clamps which retain shaft to mating couplings are supplied in matched halves. When installed, a gap will exist between the halves at the two attach bolt locations. These gaps must be equal within .030 inch.

(2) During manufacture, balance strips (weights) are pulled from shaft outside diameters, leaving residual adhesive (glue line). This causes some confusion on the part of mechanics who, upon seeing a patch of old adhesive, believe a balance weight has been lost during operation.

(3) Adjacent tail rotor drive shafts must be removed to permit replacement of hanger assy.

(4) Two tail rotor drive shafts must be disconnected from intermediate gearbox couplings to permit removal of gearbox.

TABLE XIII - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26415	Tail Rotor Gearbox	Man-Hr	4.9	0.4	0.1	3.1		0.7	0.4		0.2
		Percent		8.2	2.0	63.3		14.3	8.2		4.1
		Note				(1)					
29132	Pillow Block Assembly	Man-Hr	1.3	0.3	0.2			0.6			0.2
		Percent		23.1	15.4			46.2			15.4
2923E	Particle Separator	Man-Hr	1.8	0.3	0.3			1.0			0.2
		Percent		16.7	16.7			55.6			11.1
2931J	Droop Compen-sator Cam Box	Man-Hr	2.4	0.3	0.3			1.0		0.3	0.5
		Percent		12.5	12.5			41.7		12.5	20.8
2931J10	Linear Actuator	Man-Hr	2.1	0.2	0.2			1.0		0.5	0.2
		Percent		9.5	9.5			47.6		23.8	9.5
		Note						(2)		(3)	

(1) Replacement of tail rotor gearbox requires removal and reinstallation of tail rotor assy. Upon reinstallation, balance and track must be checked.

(2) Replacement requires removing and connecting electrical leads to the actuator terminal block. Indexing wire ends or referencing wiring diagrams is necessary to ensure proper installation.

(3) Upon installation, a rigging check is required to verify operation of the governor RPM controls. The rigging procedure is very detailed and requires a high skill level.

TABLE XIII - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
29321	RPM Warning Detector Box	Man-Hr	2.4	0.4				0.8		1.0	0.2
		Percent		16.7				33.3		41.7	8.3
		Note								(1)	
29421	Oil Tank	Man-Hr	2.1	0.3	0.2			1.0	0.3		0.3
		Percent		14.3	9.5			47.6	14.3		14.3
		Note						(2)			
29422	Oil Cooler	Man-Hr	3.1	0.4	0.2	1.1		0.9	0.2		0.3
		Percent		12.9	6.5	35.5		29.0	6.5		9.7
		Note				(3)					
29621	Tailpipe	Man-Hr	3.1	0.3	0.3	0.5		1.0			0.2
		Percent		9.7	9.7	16.1		58.1			6.5

(1) Component replacement usually requires that final alignment and adjustments be made on the aircraft while running up engine.

(2) The tank strap turnbuckles must be torqued and lockwired.

(3) Replacement requires removal and reinstallation of the blower hose, attaching brackets, blower duct (8 bolts), starter cooling duct and blower assembly (including mounting shims). This consumes a major share of the replacement task time.

TABLE XIII - Continued

Component Code and Nomenclature		Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
42111 Generator	Man-Hr	2.7	0.4	0.2			1.5	0.1		0.5
	Percent		14.8	7.4			55.6	3.7		18.5
	Note						(1)			
42211 Starter-Generator	Man-Hr	3.2	0.5	0.3	0.3	0.3	1.5	0.1		0.2
	Percent		15.6	9.4	9.4	9.4	46.9	3.1		6.3
	Note						(2,3)			

(1) The most difficult task in removal and installation is rotating and positioning the generator to disengage or engage the drive shaft with the drive quill assembly splines. The weight of the generator makes it difficult to hold and manouver.

(2) A number of different starter-generator installations are currently being used on UH-1 model helicopters. Familiarization of maintenance personnel is required for each of these installations in order to ensure proper removal and installation of the particular cooling duct and shroud assembly arrangement for that configuration.

(3) The starter-generator is located on the underside of the engine. The mounting consists of six nuts and washers which attach the unit to studs on the engine mounting pad. Removing and installing these nuts is difficult because of the limited working space available. (Figure 34).

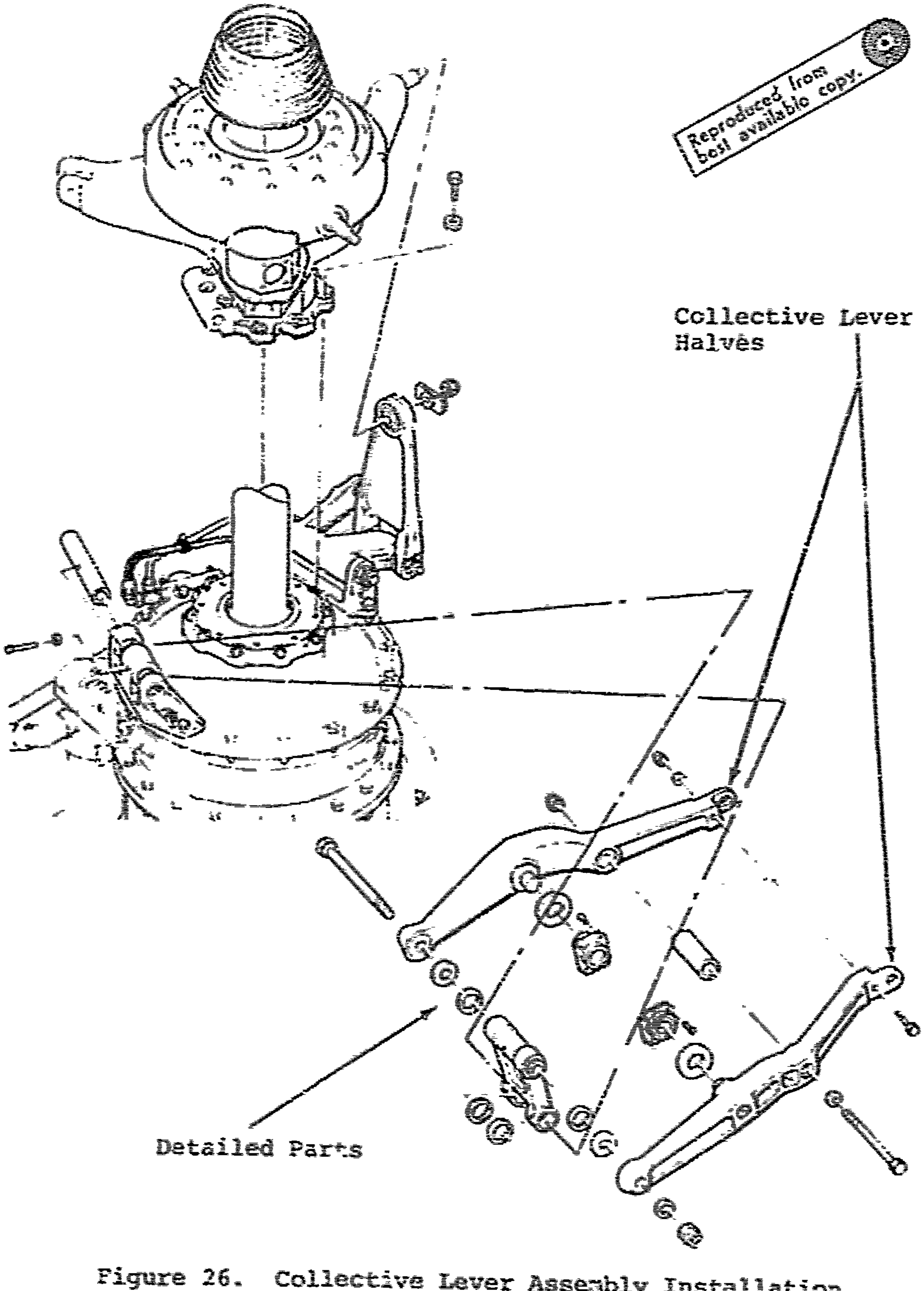


Figure 26. Collective Lever Assembly Installation, UH-1 Helicopter.

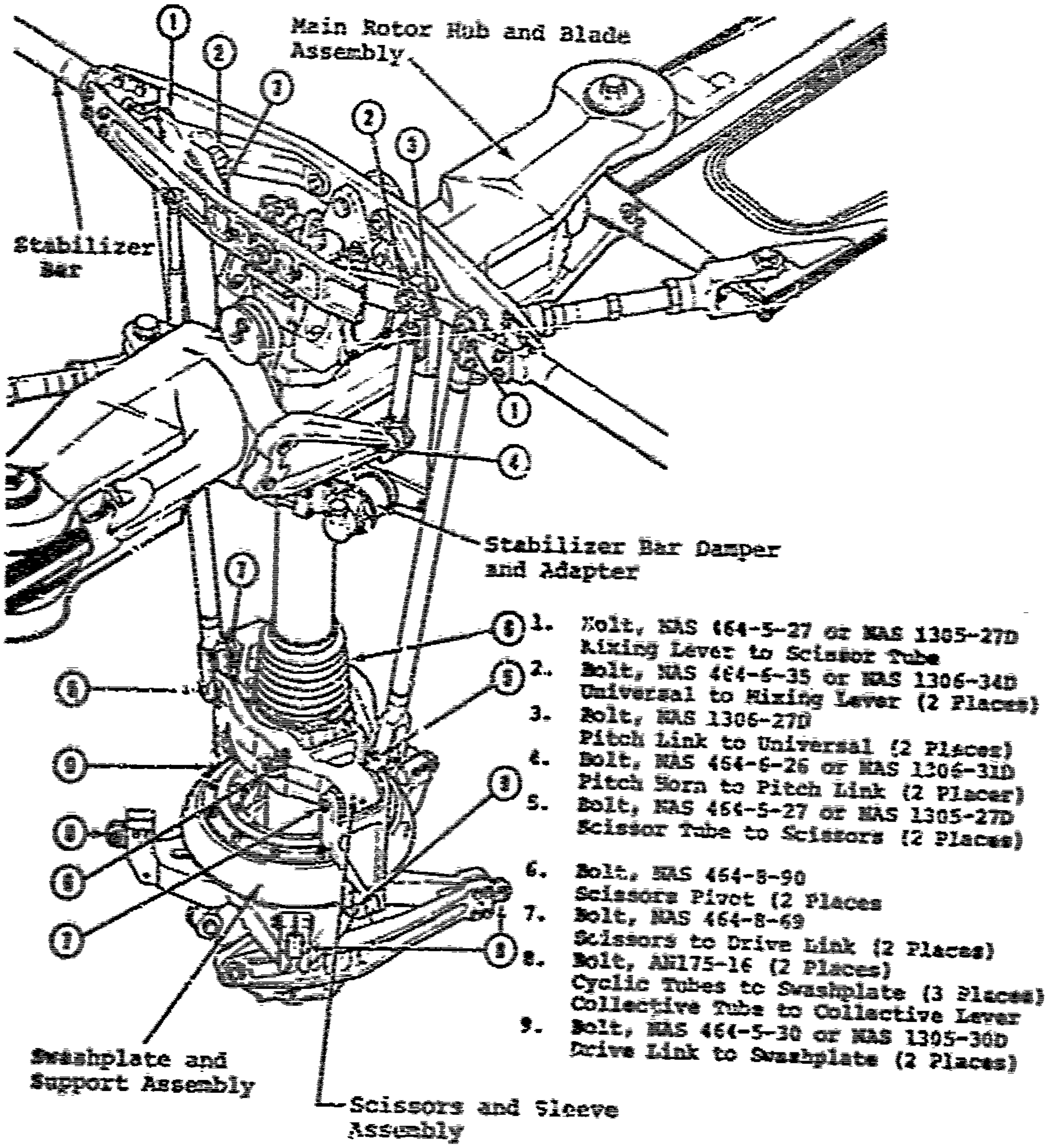


Figure 27. Swashplate and Support Assembly Installation, UH-1 Helicopter.

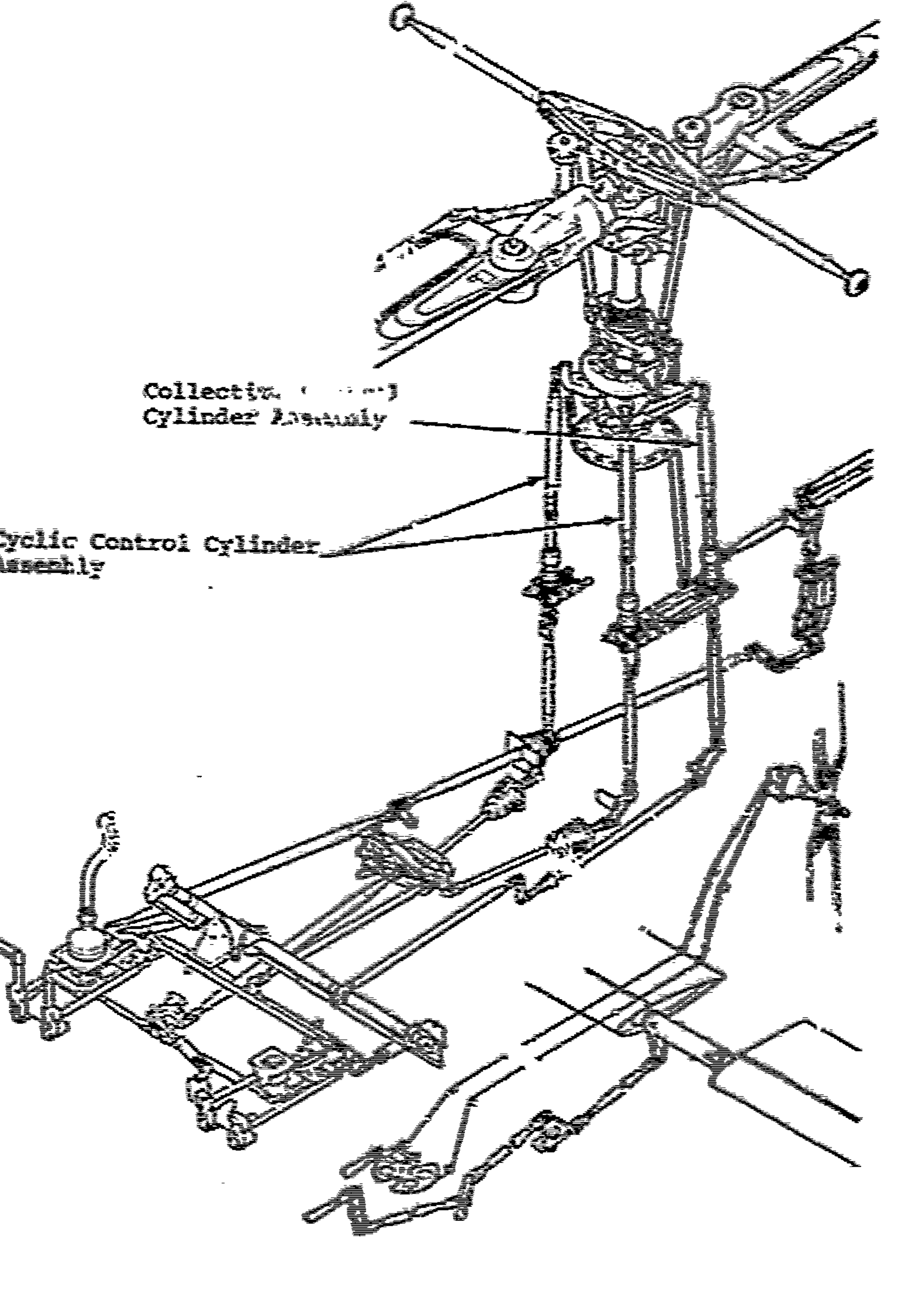


Figure 28. Flight Control System, UH-1 Helicopter.

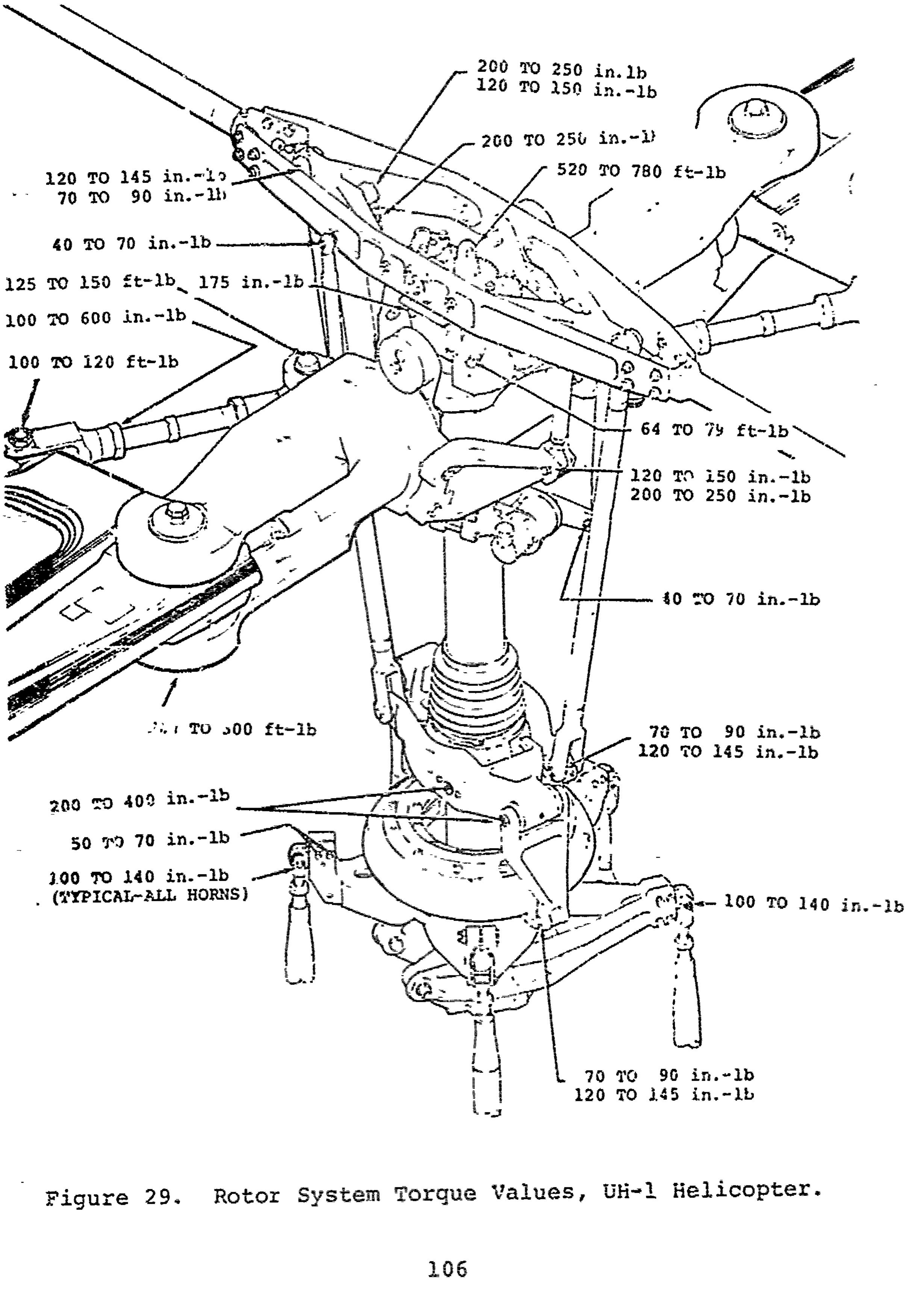


Figure 29. Rotor System Torque Values, UH-1 Helicopter.

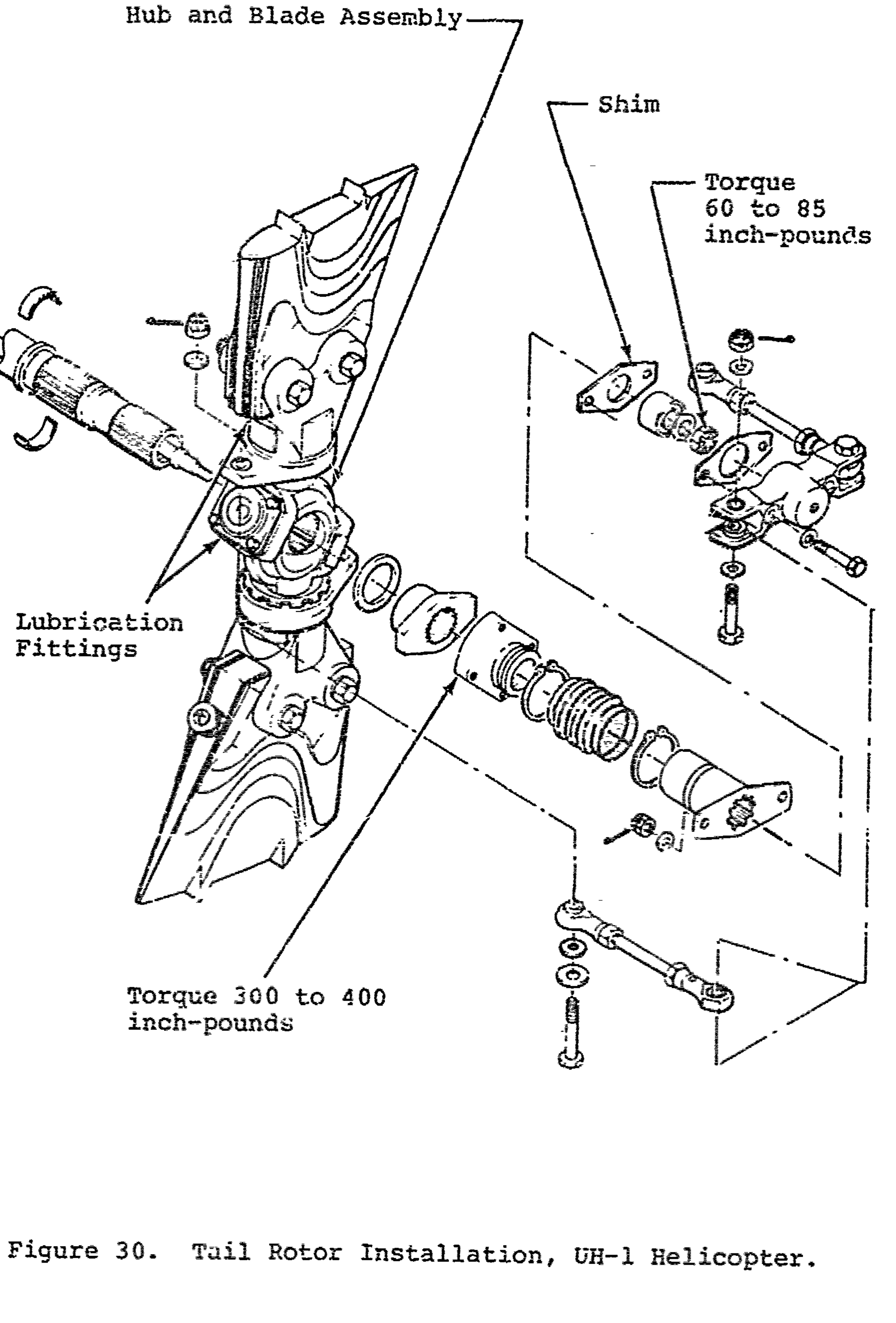
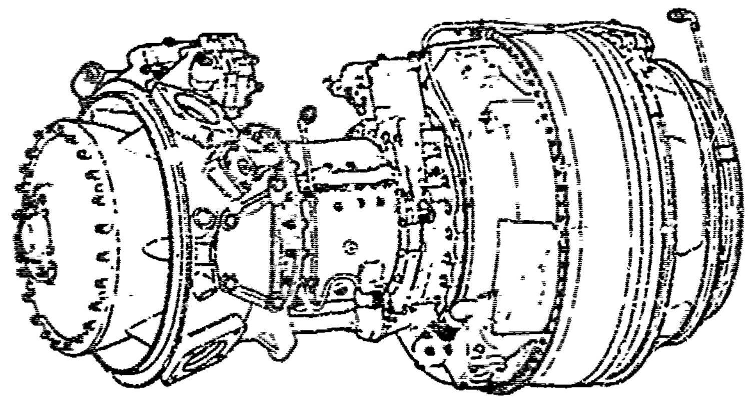


Figure 30. Tail Rotor Installation, UH-1 Helicopter.



(1) Remove retaining bolt, lockwasher, and output shaft adapter.

(2) Remove starter-generator, cable, starter-generator fan assembly, and seal drain hose as follows:

(a) Remove cooling ducts from aft end of starter-generator and at starter-generator shroud assembly.

(b) Loosen hose clamps at each side of starter-generator fan assembly, and remove hose sections from fan. Remove clamp on inlet housing, and remove long hose from engine.

(c) Remove starter-generator fan assembly and cable. Remove seal drain hose and fitting at underside of drive pad, and install plug. Install drive pad cover.

(3) Remove main electrical cable by disconnecting leads from harness and units on engine and from exhaust thermocouple connector on rear fire-wall, and by detaching cable support clamps and brackets.

(4) Remove linear actuator, governor control shaft lever, and droop compensator cambox and bracket assembly. Remove power lever control arm.

(5) Remove tachometer generators from drive pads on overspeed governor drive box and on right rear of accessory drive gearbox. Install drive pad covers.

(6) Remove fuel control inlet hose, and cap fitting.

(7) Disconnect two differential pressure switch hoses from restrictor fittings on fuel control. Replace fittings with plugs.

(8) Disconnect hoses from combustion chamber drain valve and from drain tee on fuel control drive pad.

(9) Remove governor seal drain tube and fitting and drain tee.

Figure 31. Engine Teardown Procedures, UH-1 Helicopter. (Sheet 1)

(10) Remove fuel control vent hose and fittings from inboard side of governor.

(11) Plug open ports, and cap lines.

(12) Detach support clamps and brackets of fuel differential pressure switch hose and oil pressure hose from left side of engine inlet housing.

(13) Remove oil pressure transmitters, pressure switch, brackets, and hoses.

(14) Disconnect pressure hose from oil filter.

(15) Disconnect torquemeter pressure transmitter hoses from left side of inlet housing and left front of accessory drive gearbox.

(16) Replace fittings with plugs.

(17) Remove oil pressure switch and transmitters from support, and remove support assembly from top of inlet housing.

(18) Remove oil pump inlet and outlet hoses and engine breather hose. Replace fittings with plugs.

(19) Remove bleed air hose and elbow from port at top of centrifugal compressor housing. Remove hose support clamps and bracket from engine. Install cover and gasket on studs at bleed port.

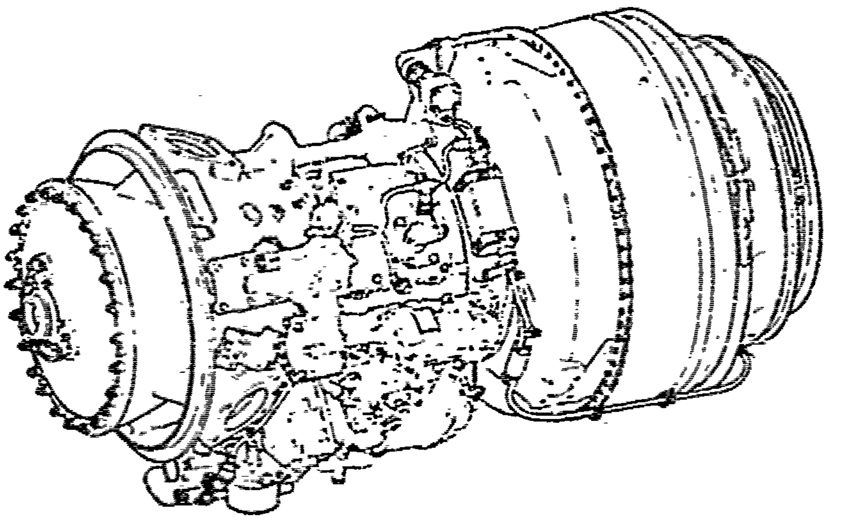
(20) Remove exhaust tailpipe with V-band coupling. Remove cover plate and attaching screws with center of exhaust diffuser.

(21) Disconnect exhaust thermocouple cable from connector on rear fire-wall.

(22) Remove upper rear fire-wall assembly by releasing V-band clamp around support cone flange and working adapter ring carefully aft over thermocouple tubing.

(23) Remove engine mount trunnions.

Figure 31. Engine Teardown Procedures, UH-1 Helicopter. (Sheet 2)



(1) Install engine mount trunnions, with any support brackets or clips normally attached on same bolts.

(2) Install oil system hoses, including breather hose, with fittings and support brackets or clips, oil pressure transmitters, and switch support assembly, complete with connecting hoses.

(3) Install two tachometer generators on mounting pads, one at rear side of overspeed governor drive gearbox and one at right rear side of accessory drive gearbox.

(4) Install droop compensator cambox, linear actuator, and governor control lever. Install power lever control arm on fuel control.

(5) Install fuel control inlet hose, fuel control seal drain and combustion chamber drain hoses, and fuel control vent hose with fittings.

(6) Remove plugs or fittings from pressure taps on fuel control pump housing. Install two restrictor fittings, and connect hoses to fuel differential pressure switch. Fuel differential pressure transmitter assembly is located on top of engine inlet housing.

(7) Install upper rear fire-wall assembly, securing adapter ring on flange of exhaust diffuser support cone with V-band coupling. Seat coupling securely and tighten clamp bolts to a torque of 40 to 50 inch-pounds.

Figure 32. Engine Build-up Procedures, UH-1 Helicopter. (Sheet 1)

(8) Connect thermocouple lead to connector on right rear side of fire-wall.

(9) Install cover plate on center of exhaust diffuser. Install exhaust tailpipe with V-band coupling. (Refer TM 55-1520-210-20).

(10) Install main electrical cable with support clips.

(11) Connect to engine electrical harness and to units mounted on engine.

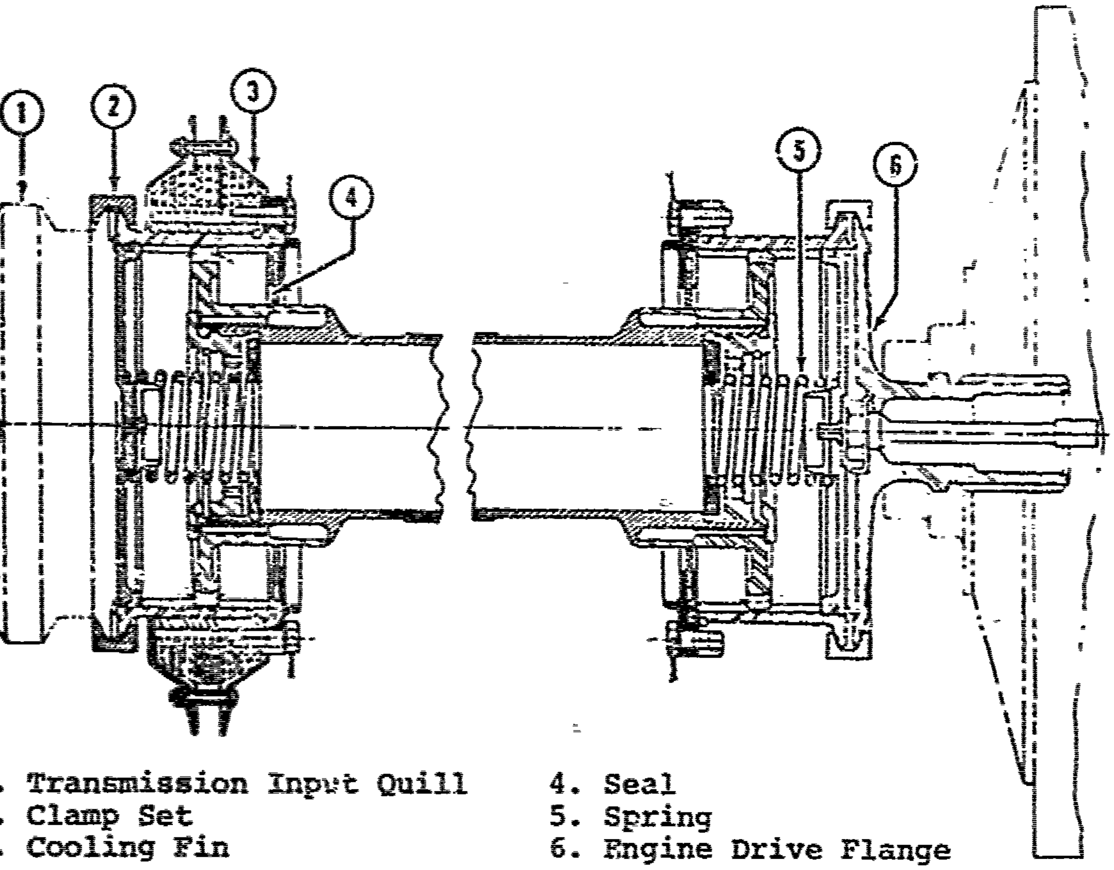
(12) Install starter-generator and starter-generator cooling fan assembly.

(13) Remove plug at bottom of drive pad and install seal drain fitting and hose. Connect cable.

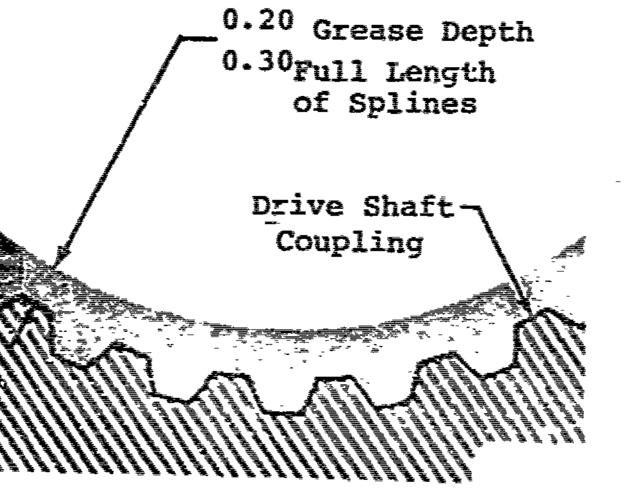
(14) Install output drive shaft adapter, with lockwasher and retaining bolts. (Refer to TM 55-1520-210-20).

(15) Check over engine and remove any remaining shipping covers or plastic plugs.

Figure 32. Engine Build-up Procedures, UH-1 Helicopter. (Sheet 2)



1. Transmission Input Quill
2. Clamp Set
3. Cooling Fin
4. Seal
5. Spring
6. Engine Drive Flange



Lubrication of Male Coupling

Apply a thin layer of grease on inboard surface of male (inner) coupling. Mate parts and move outer coupling to full outward position, with coupling bottomed.

Coat splines of female coupling with grease. Use a spatula to work out all air pockets from grease. Continue using grease until a wall 0.20 to 0.30 inch above top of splines has been built up.

Figure 33. Spline-Type Flexible Drive Coupling, Typical Lube Requirements, UH-1 Helicopter.

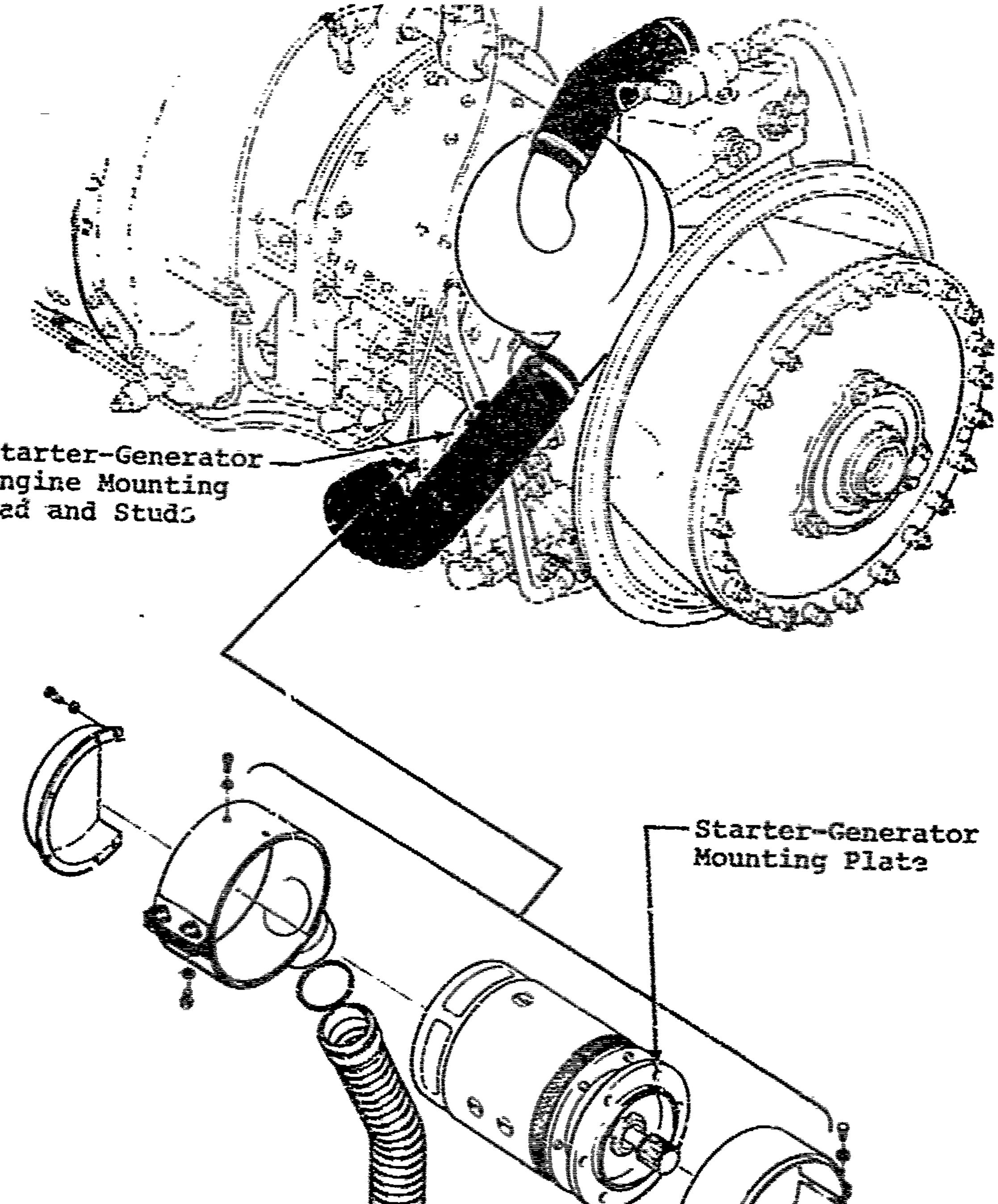


Figure 34. Starter-Generator Installation, UH-1 Helicopter.

SUMMARY OF DESIGN FACTORS RELATED TO MAJOR COMPONENT REPLACEMENT, UH-1 HELICOPTER

The more significant maintainability design characteristics of the UH-1 helicopter, within the ten major component areas covered by the study, are in summary:

1. Tail Rotor System

    a. The tail rotor hub and blade installation contains many small parts and items of hardware, the handling of which contributes significantly to the total maintenance time.

    b. During installation of the tail rotor hub, the crosshead is temporarily assembled in order to measure the gap between the retainer plate and crosshead for shimming. The process of buildup, teardown and final buildup is time-consuming.

    c. Clamps which retain the tail rotor drive shaft to mating couplings are supplied in matched halves. When installed, a gap will exist between the halves at the two attachment bolt locations. These gaps must be equal within .030 inch.

    d. Adjacent tail rotor drive shafts must be removed to permit replacement of the hanger assembly.

    e. Two tail rotor drive shafts must be disconnected from the intermediate gearbox couplings to permit removal of the gearbox.

    f. Replacement of tail rotor gearbox requires removal and reinstallation of the tail rotor assembly. Upon reinstallation, balance and track must be checked.

2. Main Rotor Hub

    Many different torque valves must be applied when installing the hub and associated hardware, with critical torques witnessed and/or verified by a technical inspector. Shimming is required to obtain proper clearance between the rotor blade and drag brace clevis.

3. Transmissions and Gearboxes

    a. Due to the arrangement of components in the power delivery train to the rotors, many components must be removed to provide access to the transmission.

b. Access to lines, hoses, transmission mounts, left link, drive shaft couplings, etc., is gained through access panel on both sides of pylon island structure and through a "hell hole" in lower fuselage under the pylon. Removal of panels is not difficult, but the resultant openings do not provide easy access to the listed components.

c. Replacement of tail rotor gearbox requires removal and reinstallation of tail rotor assembly. Upon reinstallation, balance and track must be checked.

d. Removal of the main transmission input quill requires use of special jack screws and may also require application of heat to transmission case.

4. Hydraulic Servo Actuators

a. The flight control system contains three cylinders which appear identical. Although they are not functionally interchangeable, without making certain adjustments, they can be physically interchanged.

5. Starter-Generator

a. A number of different starter-generator installations are currently being used on UH-1 model helicopters. Familiarization of maintenance personnel is required for each of these installations in order to ensure proper removal and installation of the particular cooling duct and shroud assembly arrangement for that configuration.

b. The mounting of the starter-generator consists of six nuts and washers which attach the unit to studs on the engine mounting pad. Removing and installing these nuts is difficult because of the limited working space available.

6. Swashplate and Support Assembly

a. When replacing the swashplate and support assembly, a large portion of the total maintenance effort is devoted to the task of removing and installing other components.

b. The design is such that component replacement involves disconnecting, connecting, removing,

installing and accounting for numerous parts which become loose hardware, easily misplaced by maintenance personnel.

c. The collective lever assembly includes many detailed parts which must be disassembled and reassembled during the replacement process.

7. Main Drive Shaft

a. The quantity of grease packed in couplings is critical. The packing procedure demands precision and is time-consuming. Replacement couplings are not prepacked.

b. Inspection requires disassembly of shaft and complete removal of old grease. Solvents may not be used. Some maintenance companies use cotton tipped sticks (Q-Tips) for this task. Each spline tooth is individually cleaned and visually inspected for unacceptable wear patterns and/or deterioration.

8. Power Plant Installation

a. Teardown and buildup of engine accessories represents the largest single element of the replacement task. Many steps, involving disassembly and reassembly of items in prescribed sequence, are involved in the engine buildup process.

b. The main fuel manifold is bracketed to the starting fuel manifold and mounted at the rear of the engine combustion chamber housing. Replacement tasks are hindered because of the congested area and limited space available for tool application.

c. Fire wall structure limits the available working area for on-aircraft replacement of the engine starting fuel nozzels located at the 4 and 8 o'clock positions.

d. Replacing the linear actuator requires removing and connecting electrical leads to the actuator terminal block. Indexing wire ends or referencing wiring diagrams is necessary to insure proper installation.

e. Upon installation of the linear actuator, a rigging check is required to verify operation of the governor RPM controls. The rigging procedure is very detailed and requires a high skill level.

TABLE XIV. COMPONENT REPLACEMENT DATA, AH-1 HELICOPTER

Component Code and Nomenclature			Task Element								
			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
14118	Collective Lever Assy.	Man-Hr	1.6	0.3				0.8		0.3	0.2
		Percent		18.8				50.0		18.8	12.4
		Note						(1,2)			
1412B	Cyclic Swash-plate/Support Assembly	Man-Hr	7.5	0.5		4.7		1.5		0.3	0.5
		Percent		6.7		62.6		20.0		4.0	6.7
		Note				(3)		(4,5)			

(1) The assembly consists of two collective lever halves attached to the idler link and pivoting about a bearing assembly and thrust washer on the collective sleeve. The collective lever assembly includes many small parts which must be handled during the replacement process. (Figure 35).

(2) Three different size bolts are used to attach the assembly, each having a different torque value.

(3) When replacing the swashplate and support assembly, a large portion of the total maintenance effort is devoted to the task of removing and installing other components. The principal components consist of: main rotor hub and blade assembly, scissors and sleeve assembly, boot, and anti-drive link. (Figure 35).

(4) Numerous torque values are specified for the installation.

(5) Removing and replacing the eight bolts from the lower flange of the swashplate support is time consuming due to bolt location (adjacent to link assembly), lock wiring, and torque requirements.

TABLE XIV - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
14141	Flight Control Cyl/Valve	Man-Hr	3.2	0.5	0.5	0.2	1.2	0.1			0.7
		Percent		15.6	15.6	6.3	37.5	3.1			21.9
		Note					(1)	(2)			
15115	Main Rotor Hub Assembly	Man-Hr	6.9	0.8		2.1		1.6	0.2	1.5	0.7
		Percent		11.6		30.4		23.2	2.9	21.8	10.1
		Note				(4)		(3)		(5)	

(1) The dual hydraulic cylinders are used in collective, lateral cyclic, and fore-and-aft cyclic controls. Each cylinder assembly consists of a dual cylinder and valve combination, a bearing and housing, and an extension tube on the cylinder piston rod. All three have the same cylinder, and valve group, but use different extension tubes. Valve connections on the dual hydraulic cylinder are positioned in proximity to each other. This arrangement allows little or no clearance for connecting or disconnecting the hydraulic lines. Sequential removal is required to gain access to the inboard lines. (Figure 36).

(2) The bearing housings are lubricated with grease through fitting located at the base of the cylinder assembly. These lube fittings are located in positions which provide limited access for servicing. Access to the fore-and-aft and lateral cylinder fittings is less desirable than for the collective cylinder fitting.

(3) A number of different torque values must be applied when installing the hub assembly and associated hardware, with critical torques witnessed and/or verified by a technical inspector. (Figure 37).

(4) Main rotor blade bolts frequently are difficult to remove due to seizing of the bolt. When this occurs a work aid is required to extract the bolt.

(5) Rotor tracking is normally required when the main rotor hub assembly is replaced.

TABLE XIV - Continued

Component Code and Nomenclature			Task Element								
			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
15211	Tail Rotor Hub Assembly	Man-Hr	3.6	0.3		1.2		0.8	0.1	0.7	0.5
		Percent		8.3		33.3		22.2	2.8	19.5	13.9
		Note				(1)		(2,3)		(3)	
15212	Tail Rotor Blade Assembly	Man-Hr	3.7	0.3		0.6		1.4	0.1	0.8	0.5
		Percent		8.1		16.2		37.9	2.7	21.6	13.5

(1) The tail rotor hub and blade installation contains many small parts and items of hardware, the removing and installing of which contributes significantly to the total maintenance time for component replacement. (Figure 38).

(2) During installation of the tail rotor hub, the crosshead is temporarily assembled in order to measure the gap between the retainer plate and crosshead for shimming. The process of buildup teardown, and final buildup to determine shim thickness is time consuming. (Figure 39).

(3) Many replacement actions are a result of excessive wear of parts and components, particularly bearings. The probable cause of many failures is improper system installation and rigging.

TABLE XIV - Continued

Component Code and Nomenclature			Task Element								
			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22200	T-53 Engine	Man-Hr	43.0	0.9	2.6	4.3	24.0	6.4	0.8	2.0	2.0
		Percent		2.1	6.0	10.0	55.8	14.9	1.9	4.7	4.7
		Note			(4)	(3)	(1)	(2)		(2)	(2)
22261	Fuel Regulator	Man-Hr	6.0	1.0	0.1	1.0		2.5	0.1	0.8	0.5
		Percent		16.7	1.7	16.7		41.7	1.7	13.3	8.2
22277	Oil Hose	Man-Hr	1.3	0.2	0.2			0.3	0.3		0.3
		Percent		15.4	15.4			23.1	23.1		23.1

(1) Teardown and buildup of the basic engine, which includes removing accessories from the old engine and installing them on the new one, represents the largest element of the replacement function. Many steps involving disassembly and reassembly of the adapting parts in prescribed sequence are involved.

(2) The replacement requires checking main drive shaft alignment and control linkage rigging. Servicing and ground functional checks are also required.

(3) Engine ignition leads are worn and chafed by a rubbing action on the engine cowl hinge bar/tube. Probable cause is improper adjustment of the door hinge assembly.

(4) Engine and transmission cowling is attached to hinges with a nut, bolt, and washer arrangement. Engine changes require removing the cowling which includes removing the attaching hardware. The removal of this hardware is time consuming, and once removed, it becomes loose hardware, presenting an FOD hazard.

TABLE XIV - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26111	Main Drive Shaft	Man-Hr	3.4	0.2	0.3	0.3		0.7	1.1		0.8
		Percent		5.9	8.8	8.8		20.6	32.4		23.5
		Note							(1)		(2)
2621C	Mast Assembly	Man-Hr	8.3	0.3	0.6	2.9		3.7			0.8
		Percent		3.6	7.3	34.9		44.6			9.6
		Note				(3,4)					(5)

(1) The quantity of grease packed in couplings is critical. The packing procedure demands precision and is time-consuming. Replacement couplings are not prepacked. (Figure 33).

(2) *Inspection requires* disassembly of shaft and complete removal of old grease. Solvents may not be used. Some maintenance companies used cotton tipped sticks (Q-Tips) for this task. Each spline tooth is individually cleaned and visually inspected for unacceptable wear patterns and/or deterioration.

(3) Due to the location of the mast assy. in the power delivery train to the main rotor, it's removal requires the prior removal of the main rotor blades, main rotor hub, and swashplate and support assy.

(4) A small diameter roll pin is used to lock the collet clamping nut in the mast controls installation. The pin is difficult to remove/install and often the nut is damaged or the drift (tool) is broken. (Figure 35).

(5) Occasionally, precautionary mast replacements are made for lack of an adequate method for checking the depth of scratches. Maximum permissible depth of a repairable scratch is .010 inch.

TABLE XIV - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
2621E	Main Input Quill Assembly	Man-Hr	6.4	0.5	0.6	0.9		4.0			0.4
		Percent		7.8	9.4	14.1		62.5			6.2
		Note						(1,2,3)			
2621J	Tubing (Main Transmission)	Man-Hr	1.1	0.2	0.4			0.5			
		Percent		18.2	36.4			45.4			
2621K	Hose (Main Transmission)	Man-Hr	1.4	0.2	0.4			0.8			
		Percent		14.3	28.6			57.1			

(1) Removal of quill requires use of special jack screws and may also require application of heat to transmission case.

(2) During installation of the quill, a rubber plug is temporarily positioned in the roller input bearing to hold the rollers against their outer race, thereby permitting insertion of inner race which is part of quill assembly. The rubber plug must be inserted in the roller bearing from inside the transmission. This is accomplished through an unused mounting port on the left-hand side of the transmission.

(3) Installation of quill requires application of heat to transmission case.

Component Code and Nomenclature			Task Element								
			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26211	Main Trans- mission Assembly	Man-Hr Percent No [illegible]	27.[illegible]	0.6 2.2	1.9 7.0 (2,3)	6.4 23.5 (1)	4.0 14.7	8.9 32.7	0.8 2.9	2.0 7.4	2.6 9.0
26411	Tail Rotor Drive Shaft Assembly	Man Hr Percent [illegible]	1.6	0.1 6.3	0.6 37.4			0.9 56.3 (4,5)			

(1) Due to the arrangement (physical location) of components in the power delivery train to the rotors, many components must be removed to provide access to the transmission. These include main rotor blades, main rotor hub, swashplate and support assembly, control rods and drive shafts.

(2) The two center sections of pylon fairing are constructed of fiberglass and retained by many phillips head screws. Removal and reinstallation of these fairings is time-consuming.

(3) The transmission cowl doors have hinges which require custom fitting (shims) upon reinstallation. (Figure 39).

(4) Clamps which retain shaft to mating couplings are supplied as matched halves. When installed, a gap will exist between the halves at the two attach bolt locations. These gaps must be adjusted to be equal within .030 inch.

(5) During manufacture, balance strips (weights) are pulled from shaft outside diameters, leaving residual adhesive (glue line). This causes some confusion on the part of mechanics who, upon seeing a patch of old adhesive, believe a balance weight has been lost during operation.

TABLE XIV - Continued

Component Code and Nomenclature			Task Element								
			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove / Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26413	Hanger Assembly	Man-Hr	1.9	0.2	0.1	1.3		0.3			
		Percent		10.5	5.3	68.4		15.8			
		Note				(1)					
26414	Intermediate Gearbox	Man-Hr	2.6	0.2	0.3	0.7		0.7	0.4		0.3
		Percent		7.7	11.5	26.9		15.4			11.6
		Note						(2)			
26415	Tail Rotor Gearbox Assembly	Man-Hr	4.8	0.3	0.3	3.0		0.6	0.4		0.2
		Percent		6.3	6.3	62.5		12.5	8.3		4.2
		Note				(3)					
29132	Pillow Block Assembly	Man-Hr	1.3	0.3	0.2			0.6			0.2
		Percent		23.1	15.4			46.1			15.4

(1) Adjacent tail rotor drive shafts must be removed to permit replacement of hanger assy.

(2) Two tail rotor drive shafts must be disconnected from intermediate gearbox couplings to permit removal of gearbox.

(3) Replacement of tail rotor gearbox requires removal and reinstallation of tail rotor assembly. Upon reinstallation, balance and track must be checked.

TABLE XIV - Continued

Component Code and Nomenclature			Task Element								
			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove / Install Compon- ent	Dr. 'n Lube Service	Adjust Align Track Etc.	Inspect And Test
29133	Tripod Assembly	Man-Hr	2.0	0.3	0.2			1.0		0.3	0.2
		Percent		15.0	10.0			50.0		15.0	10.0
		Note								(1)	(1)
2931J	Droop Compensator Cambox	Man-Hr	2.3	0.2	0.3			1.0		0.3	0.5
		Percent		8.7	13.0			43.6		13.0	21.7
2931J10	Linear Actuator	Man-Hr	2.3	0.2	0.2			1.2		0.5	0.2
		Percent		8.7	8.7			52.2		21.7	8.7
		Note								(2)	
29321	RPM Warning Limit Detection Box	Man-Hr	2.4	0.4	0.1			0.7		1.0	0.2
		Percent		16.7	4.1			29.2		41.7	8.3
		Note								(3)	

(1) When reinstalling the tripod assembly, a check of main drive shaft alignment and control linkage adjustment is required.

(2) Replacement of the linear actuator normally requires rigging the power turbine governor RPM controls and making necessary adjustments for actuator stroke. This process includes a number of detailed steps involving precise measurement adjustments. (Figure 40).

(3) Replacement of the detector unit necessitates a test of the RPM limit warning system. The test requires engine turn-up and fine tuning of the unit to align within specified limits.

TABLE XIV - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove / Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
29422	Oil Cooler	Man-Hr	4.2	0.8	0.7	0.6	0.2	1.1	0.5		0.3
		Percent		19.0	17.0	14.0	5.0	26.0	12.0		7.0
42211	Starter/ Generator	Man-Hr	3.3	0.5	0.4	0.3	0.3	1.5	0.1		0.2
		Percent		15.2	12.1	9.0	9.0	45.5	3.1		6.1
		Note				(1)		(1,2)			
575C1	SCAS Control Assembly	Man-Hr	2.0	0.8	0.1			0.5		0.3	0.3
		Percent		40.0	5.0			25.0		15.0	15.0
		Note						(3)			

(1) The starter-generator is mounted on an accessory drive pad located on the lower side of the engine. Access to the six mounting nuts and studs involves: removing a clamp and detaching the flexible hose duct from the shroud on forward end of the starter-generator, loosening two clamping bolts at the left side of inlet shroud and sliding the shroud aft. These functions are the large contributors to the component replacement time.

(2) Removing and installing the top inboard mounting nuts is difficult due to limited work space.

(3) Although the unit is located in an accessible location for maintenance, its exposed location behind the pilot's seat makes it vulnerable to damage from articles stowed in the compartment. (Figure 41).

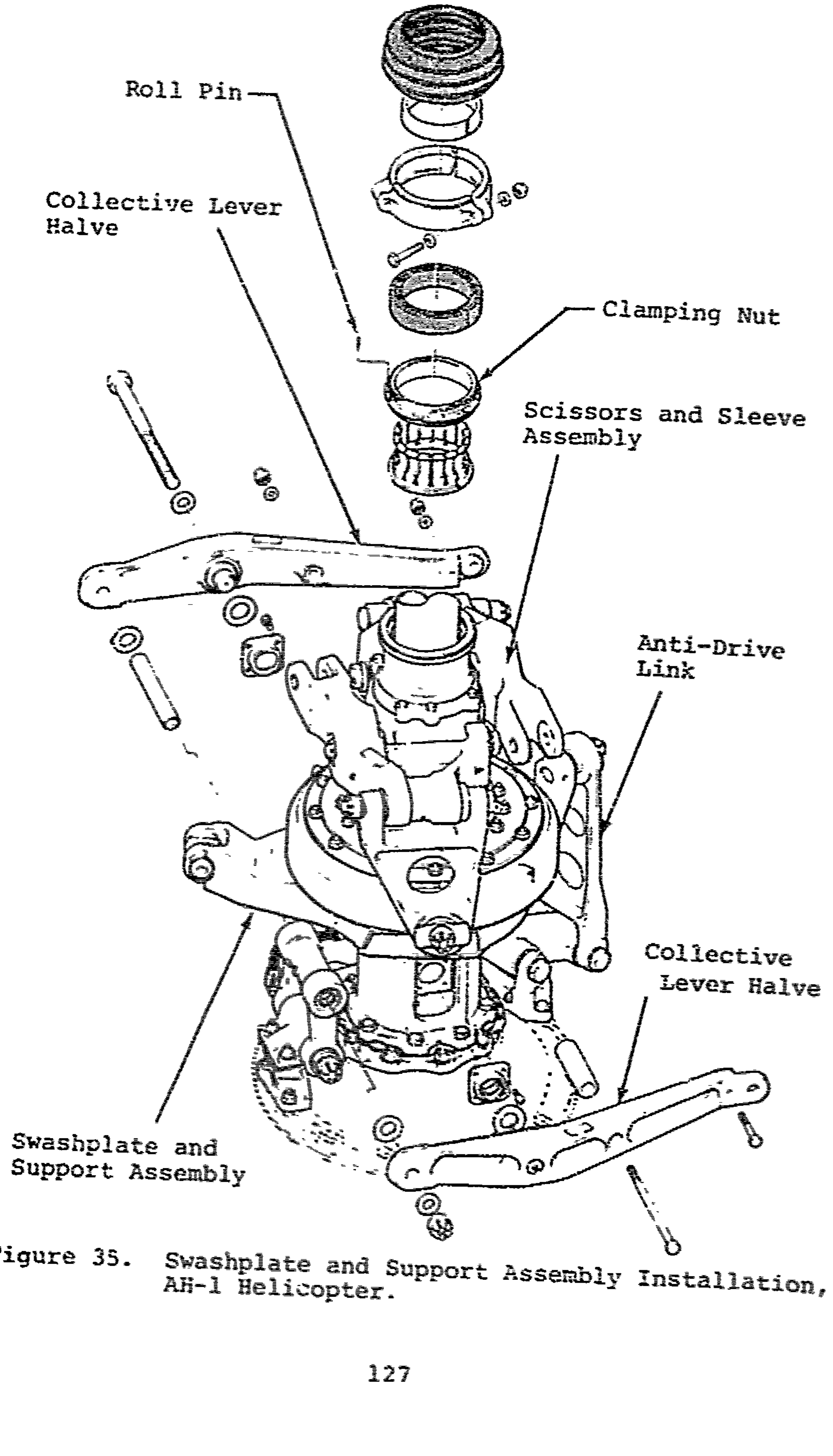


Figure 35. Swashplate and Support Assembly Installation, AH-1 Helicopter.

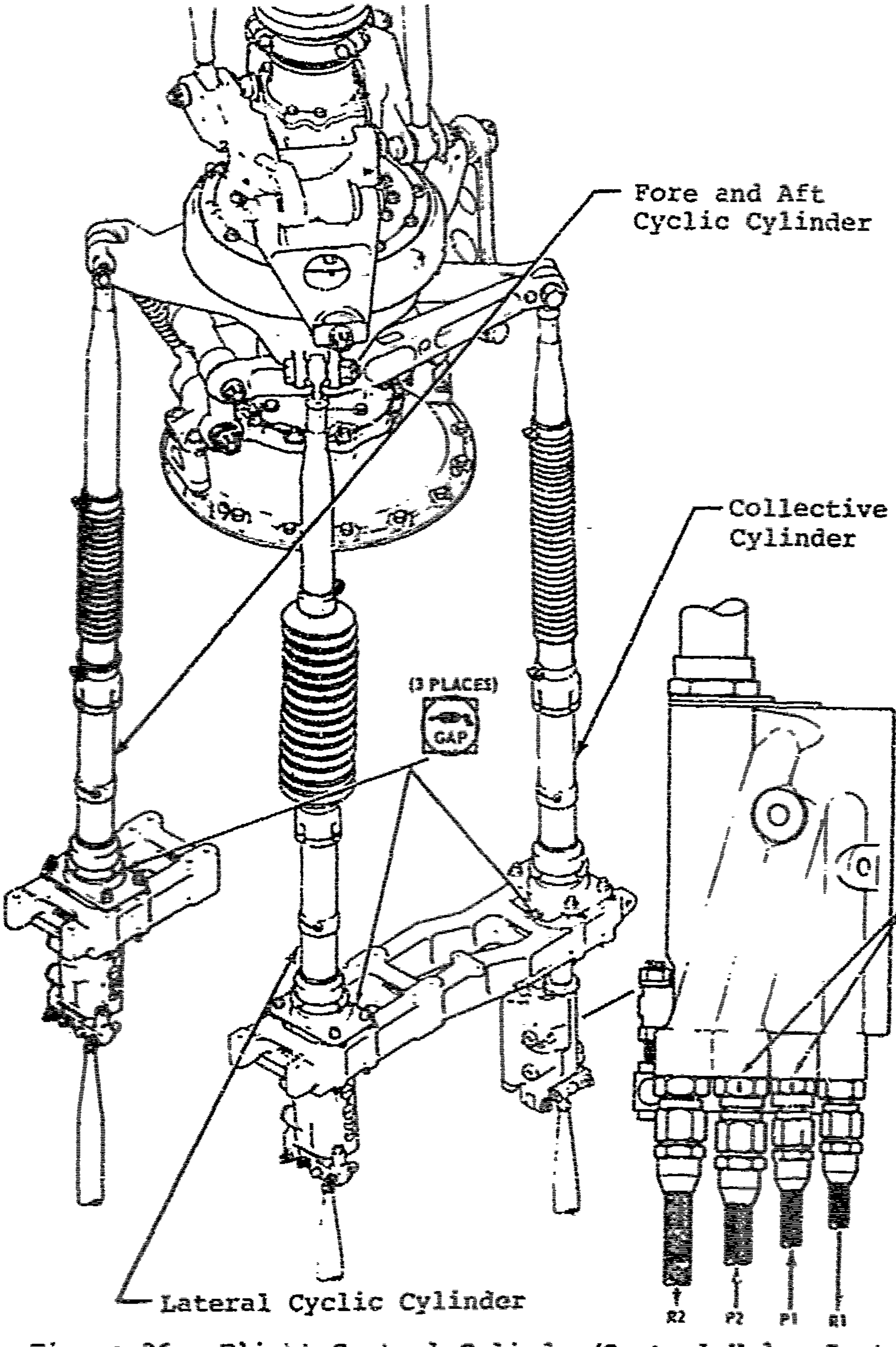


Figure 36. Flight Control Cylinder/Control Valve Installation, AH-1 Helicopter.

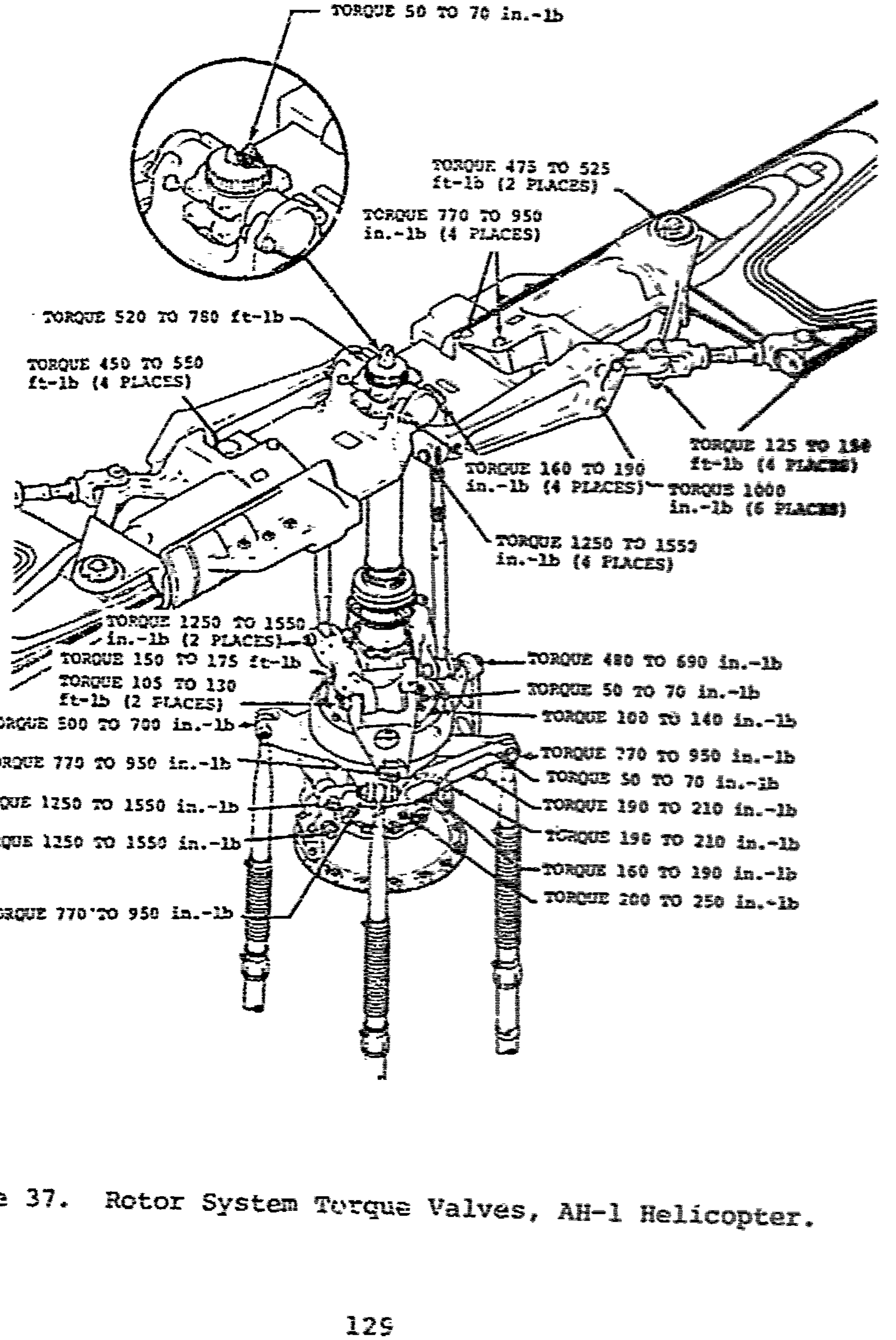


Figure 37. Rotor System Torque Valves, AH-1 Helicopter.

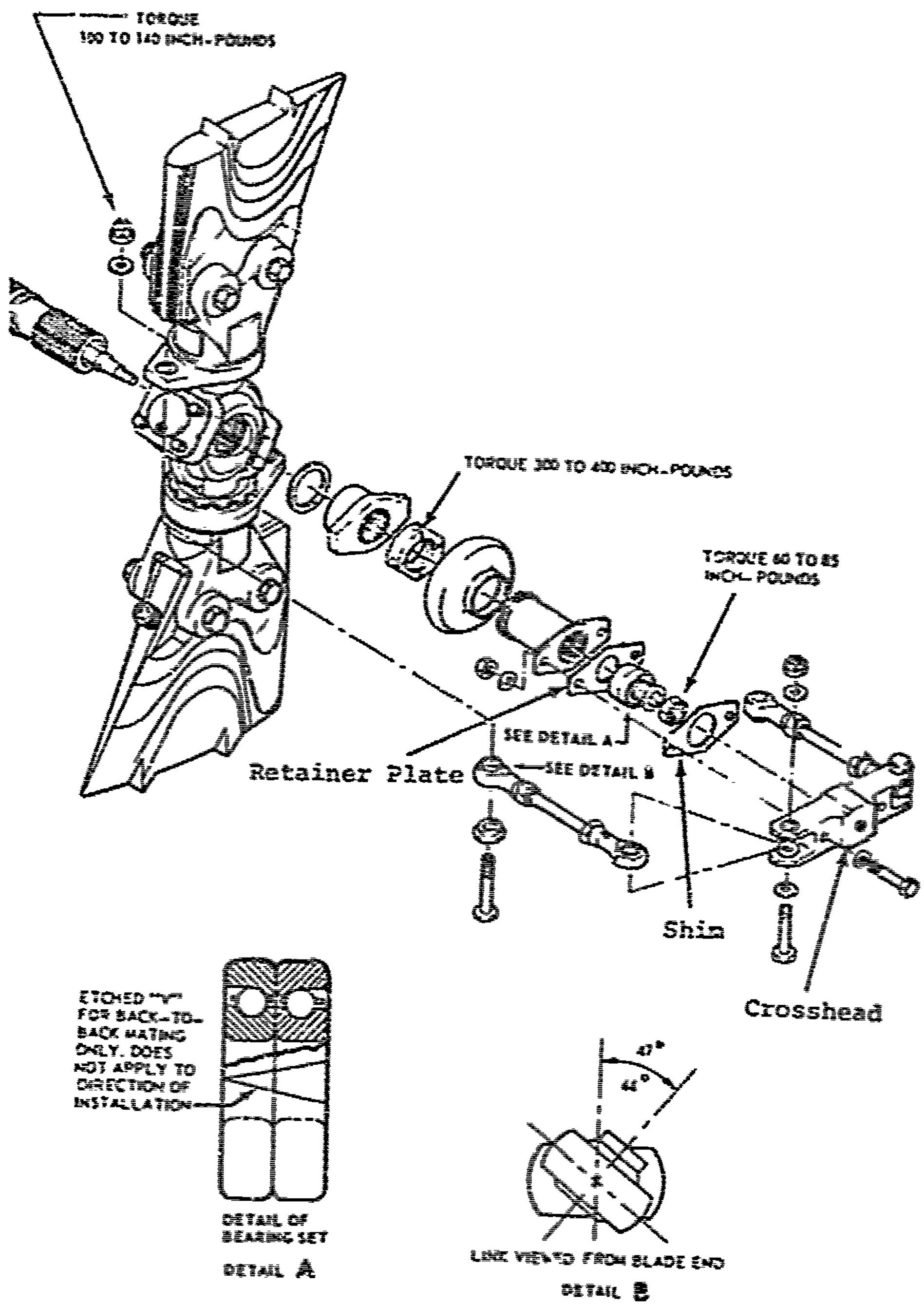


Figure 38. Tail Rotor Installation, AH-1 Helicopter.

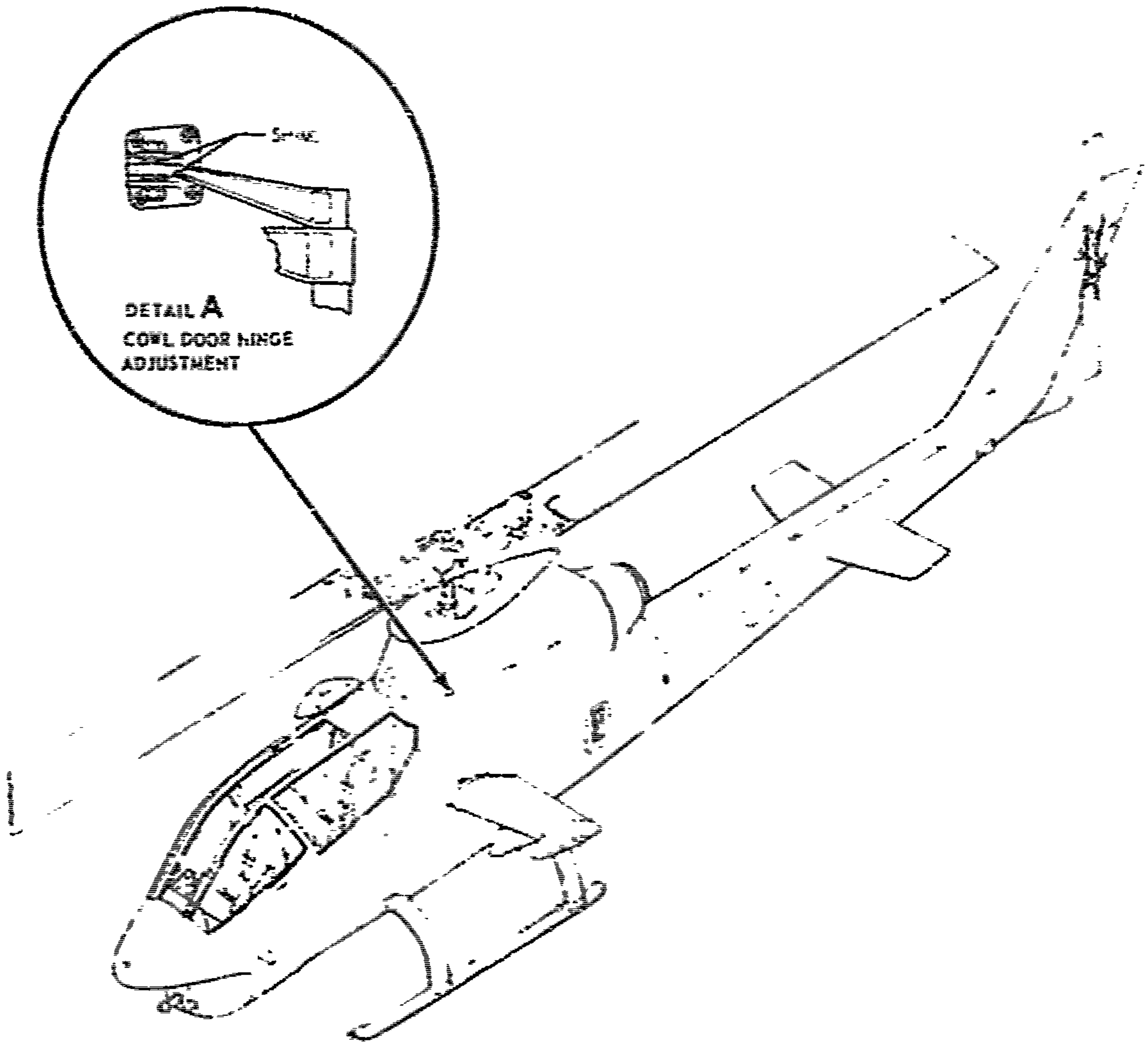


Figure 39. Hinge Adjustment for Transmission Cowl Doors, AH-1 Helicopter.

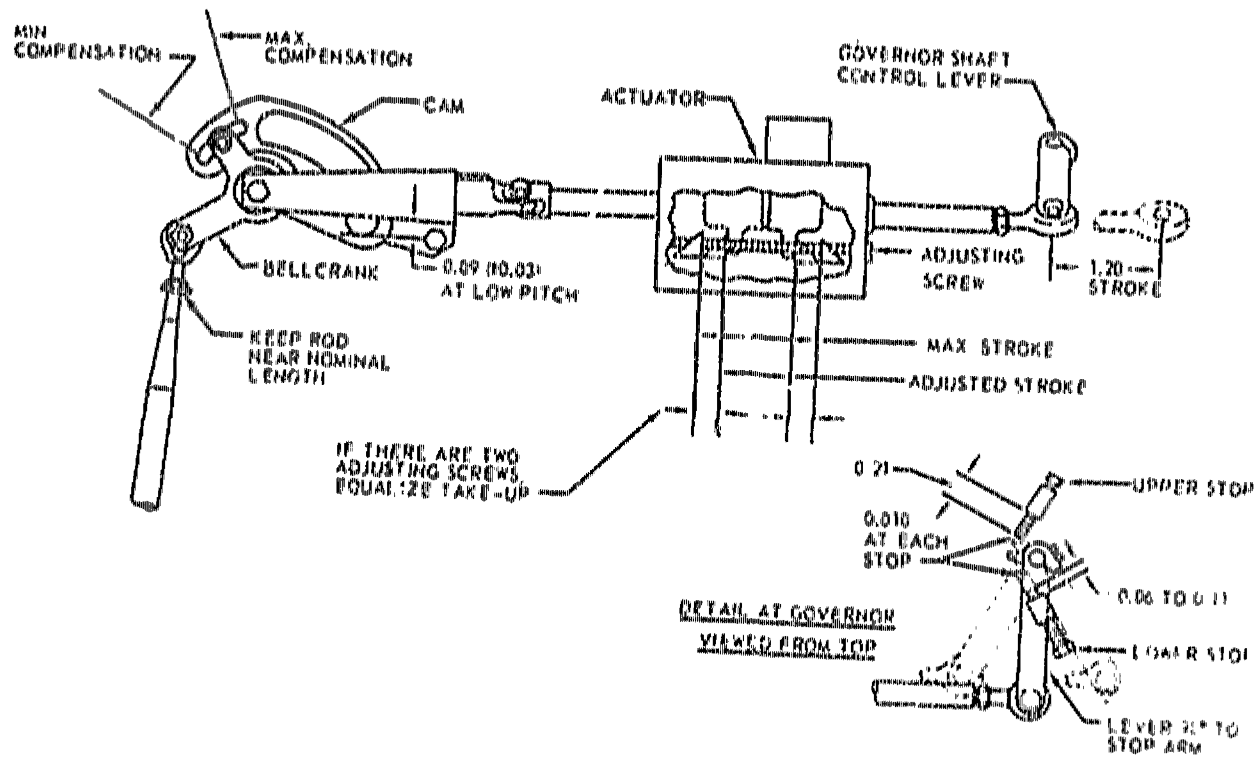


Figure 40. Governor RPM Controls Rigging, AH-1 Helicopter.

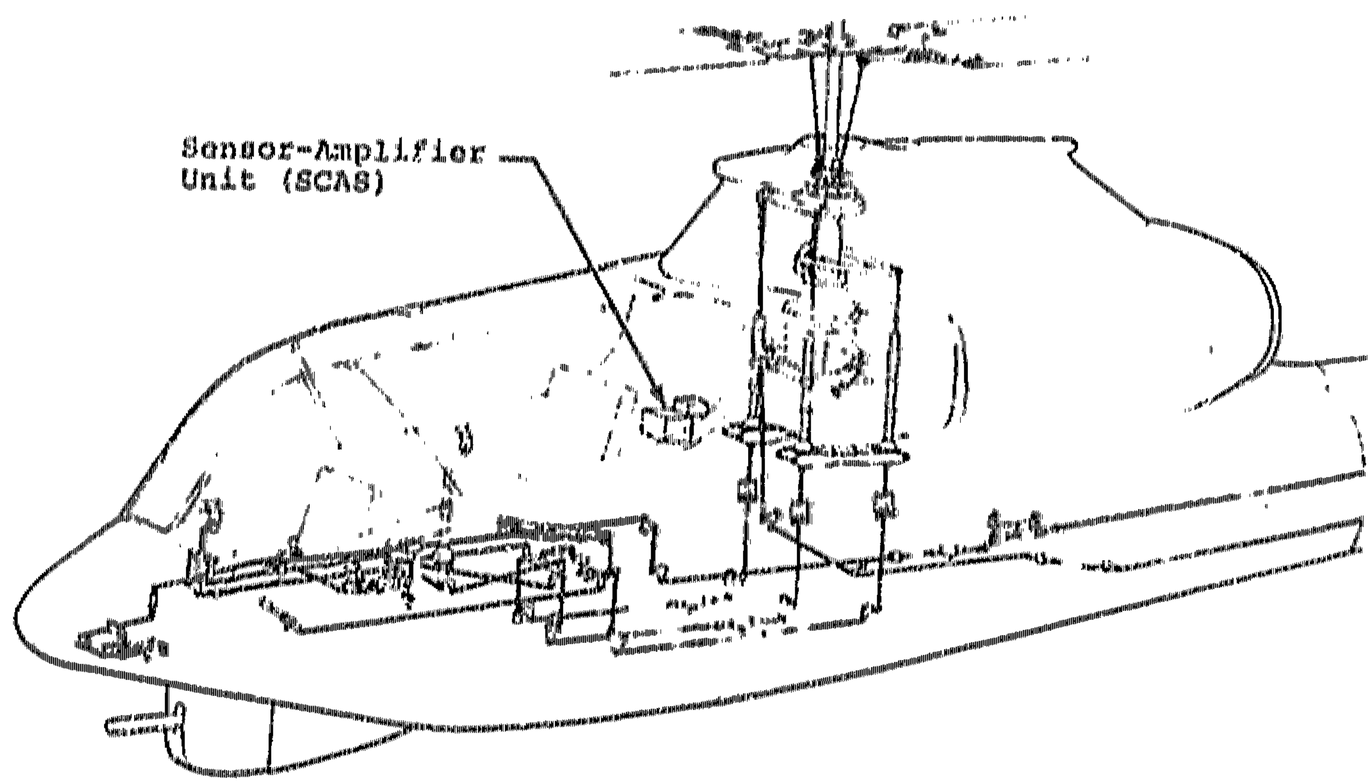


Figure 41. Stability and Control Augumentation System, AH-1 Helicopter.

SUMMARY OF DESIGN FACTORS RELATED TO MAJOR COMPONENT REPLACEMENT, AH-1 HELICOPTER

The more significant maintainability design characteristics of the AH-1 helicopter, within the ten major component areas covered by the study, are in summary:

1. Tail Rotor System

   a. The tail rotor hub and blade installation contains many small parts and items of hardware, the removing and installing of which contributes significantly to the total maintenance time for component replacement.

   b. During installation of the tail rotor hub, the crosshead is temporarily assembled in order to measure the gap between the retainer plate and crosshead for shimming. The process of buildup, teardown and final buildup to determine shim thickness is time-consuming.

   c. Many replacement actions are a result of excessive wear of parts and components, particularly bearings. The probable cause of many failures is improper system installation and rigging.

2. Main Rotor Hub

   a. A number of different torque valves must be applied when installing the hub assembly and associated hardware, with cirtical torques witnessed and/or verified by a technical inspection.

   b. The main rotor blade bolts frequently are difficult to remove due to seizing of the bolt. When this occurs, a work aid is required to extract the bolt.

   c. Rotor tracking is normally required when the main rotor hub assembly is replaced.

3. Stability Augmentation System

   Although the SCAS control unit is located in an accessible location for maintenance, its exposed

location behind the pilot's seat makes it vulnerable to damage from articles stowed in the compartment.

4. Transmission and Gearboxes

   a. Due to the arrangement of components in the power delivery train to the rotors, many components must be removed to provide access to the transmission.

   b. The transmission cowl door have hinges which require custom fitting (shims) upon reinstallation.

5. Hydraulic Servo Actuators

   a. Valve connections on the dual hydraulic flight control cylinders are positioned in proximity to each other. This arrangement allows little or no clearance for connecting or disconnecting the hydraulic lines. Sequential removal is required to gain access to the inboard lines.

   b. The bearing housing of the flight control cylinder valve is lubricated with grease through fittings located at the base of the cylinder assembly. These lube fittings are located in positions which provide limited access for servicing.

6. Starter-Generator

   a. Access to the six mounting nuts and studs involves removing a clamp and detaching the flexible hose duct from the shroud on the forward end of the starter-generator, loosening the two clamping bolts at the left side of the inlet shroud, and sliding the shroud aft. These functions are the larger contributors to the component replacement time.

   b. Removing and installing the top inboard mounting nuts is difficult due to limited work space.

7. Swashplate and Supporting Assembly

   a. When replacing the swashplate and support assembly, a large portion of the total maintenance effort is devoted to the task of removing and installing other components.

b. Numerous torque valves are specified for the swashplate installation.

c. The collective lever assembly includes many small parts which must be handled during the replacement process.

8. Main Drive Shaft

a. The quantity of grease packed in couplings is critical. The packing procedure demands precision and is time-consuming. Replacement couplings are not prepacked.

b. Inspection requires disassembly of shaft and complete removal of old grease. Solvents may not be used. Each spline tooth is individually cleaned and visually inspected for unacceptable wear patterns and/or deterioration.

9. Power Plant Installation

a. Teardown and buildup of the basic engine, which includes removing accessories from the old engine and installing them on the new one, represents the largest element of the replacement function. Many steps, involving disassembly and reassembly of the adapting parts in prescribed sequence, are involved.

b. Engine replacement requires checking main drive shaft alignment and control linkage rigging. Servicing and ground functional checks are also required.

c. Replacement of the linear actuator normally requires rigging the power turbine governor RPM controls and making necessary adjustments for actuator stroke. This process includes a number of detailed steps involving precise measurement of adjustments.

d. When reinstalling the tripod assembly, a check of the main drive shaft alignment and control linkage adjustment is required.

TABLE XV. COMPONENT REPLACEMENT DATA, CH-47 HELICOPTER

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
14021	Swashplate Control	Man-Hr	14.1	0.8	0.3	8.0		3.0		1.0	1.0
		Percent		5.7	2.1	56.7		21.3		7.1	7.1
		Note				(1)					
14060	Drive Arm Assembly	Man-Hr	1.8	0.5	0.3	0.3		0.5			0.2
		Percent		27.8	16.7	16.7		27.8			11.1
15008	Rotary-Wing Head Assembly	Man-Hr	10.8	0.8	0.2	4.5		3.1	0.2	1.5	0.5
		Percent		7.4	1.9	41.7		28.7	1.9	13.9	4.6
		Note				(2)		(2,3)	(3)		
15102	Shock Absorber	Man-Hr	2.3	0.4	0.3			0.9	0.4		0.3
		Percent		17.4	13.0			39.1	17.4		13.0

(1) A large portion of the total maintenance time is required for removal and installation of other components: rotor blades, rotor hub, and weather protection cover. Because of the size and weight of these items, handling requires at least three maintenance personnel and special equipment. (Figure 42)

(2) A number of special tools and equipment are needed to replace either the forward or aft rotary-wing head assembly. The setup, use and teardown of these items contribute significantly to the maintenance time. (Figure 42)

(3) Draining oil from the bearing oil tank and pitch varying housing is difficult due to the lack of space below the drain plug in which to place a container. The oil must be diverted outboard by a tray or chute to the container. (Figure 42)

TABLE XV - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
15133	Rotor Head Boot Assembly	Man-Hr	1.9	0.1	0.3	0.3		1.0			0.2
		Percent		5.3	15.8	15.8		52.7			10.5
		Note						(1)			
15170	Rotary-Wing Head Oil Tank	Man-Hr	1.2	0.1	0.3			0.4	0.2		0.2
		Percent		8.3	25.0			33.3	16.7		16.7
15234	Spring Droop Stop	Man-Hr	1.7	0.3	0.5			0.6			0.3
		Percent		17.6	29.4			35.3			17.6
		Note						(2)			
15271	Droop Stop (Static)	Man-Hr	1.6	0.3	0.3			0.8			0.2
		Percent		18.8	18.8			50.0			12.5
		Note						(3,4)			

(1) The method of attaching the boot at the pitch link fairing or turnbuckle and at the rod-end bearing involves wrapping and tieing twine around the boot. The procedure is somewhat involved and requires dexterity to insure a proper tie. (Figure 43)

(2) The assembly contains several small detail parts including washers, a bearing, and springs. Care is required during disassembly to prevent loss of parts. The maintenance procedure specifies that the bolt be temporarily installed through the limiters, spring, washers and bearing to prevent such loss.

(3) The droop stops are bolted to the pitch, varying shaft below the horizontal pin. The stops are not interchangeable between forward and aft rotary-wing heads, but are interchangeable between pitch shafts on either head. This arrangement makes it possible to install the stops in the wrong location.

(4) The replacement of the fixed droop stop requires rotating the rotary-wing head until the blade is centered over the fuselage walkway, restraining the other blades to prevent rotating the head, and lifting and supporting the blade so that the droop stop is clear of the hub.

TABLE XV - Continued

Component Code and Nomenclature		Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22004 Turbine Engine	Man-Hr	77.6	1.0	0.5	1.5	60.0	12.0	0.8	0.8	1.0
	Percent		1.3	0.6	1.9	77.3	15.5	1.0	1.0	1.3
	Note				(1)	(2,3)	(4,5)			
22074 Fire Detection Sensing Element	Man-Hr	1.7	0.3	0.2			1.0			0.2
	Percent		17.6	11.8			58.8			11.8
	Note						(6)			

(1) The fuel distributor and dump valve is located at the rear of the engine in the 6 o'clock position. Sequential disassembly and attachment of the fuel lines is necessitated by the proximity of the fittings.

(2) The major man-hour consumer is off-aircraft teardown and buildup (approximately 40-60 man hours). Numerous plumbing line runs in proximity to one another and to various engine accessories contributing to chafing problems and restrict access for accessory replacement and engine adjustments.

(3) The flange on the anti-icing fairing hot air valve has studs mounted in a downward direction which hampers removal and installation of the attaching nuts. (Figure 44)

(4) The maintenance crane provided for removal of engines, transmissions and rotor components is difficult to assemble and disassemble and to operate. Overhead cranes or vehicle wreckers are frequently used in lieu of the crane.

(5) The inboard engine mount is located in a high-density area with severly restricted access. A standard wrench, modified locally, improves access to the mount attachment, but the task of removal and installation is still difficult.

(6) The sensing element is a wire enclosed in and insulated from a thin metallic tube. Each engine has three elements which are routed around the engine behind plumbing lines and engine components. The installation, coupled with the need to avoid crushing the fragile element, makes replacement difficult. (Figure 45)

TABLE XV - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
22101	Engine Oil Pump	Man-Hr	5.4	0.5	0.2	2.4		1.1	0.6	0.3	0.3
		Percent		9.3	3.6	44.4		20.4	11.1	5.6	5.6
		Note				(1)					
22128	Power Turbine Control Actuator	Man-Hr	2.3	0.5	0.2			0.5		0.8	0.3
		Percent		21.7	8.0			21.7		34.8	13.0
22157	Engine Starter	Man-Hr	2.6	0.3	0.2	0.7	0.2	0.8	0.1		0.3
		Percent		11.5	7.7	26.9	7.7	30.8	3.8		11.5
		Note						(2)	(2)		
22310	Engine Exhaust Cone	Man-Hr	1.7	0.2	0.2	1.1					0.2
		Percent		11.8	11.8	64.6					11.8
		Note				(3)					

(1) The installation is such that the fuel purifier or fuel boost pump, and the gas producer tach generator, must be removed to replace the oil pump.

(2) Replacement necessitates disconnecting five flexible hoses from stationary fittings on the starter motor while holding a container under the fittings to catch hydraulic fluid. Spillage and cleanup often result.

(3) Maintenance procedures require that the tail pipe assembly be removed prior to replacing the engine exhaust cone.

TABLE XV - Continued

Component Code and Nomenclature			Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ant	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22357	Engine Tail- Pipe Assembly	Man-Hr	1.8	0.2	0.2	0.7		0.5			0.2
		Percent		11.1	11.1	38.9		27.8			11.1
		Note				(1)		(1)			
24009	Auxiliary Power Unit	Man-Hr	5.4	0.3	0.6	0.8	0.8	2.3	0.3		0.3
		Percent		5.5	11.1	14.8	14.8	42.5	5.6		5.6
		Note						(2)			
24169	APU Hydraulic Pump-Motor	Man-Hr	3.1	0.3	0.6		0.2	1.3	0.5		0.2
		Percent		9.6	19.3		6.4	41.9	16.1		6.4
		Note						(3)			
24304	APU Fuel Pressure Switch	Man-Hr	1.4	0.2	0.6			0.4			0.2
		Percent		14.3	42.8			28.6			14.3
24376	APU Fuel Boost Pump	Man-Hr	1.8	0.2	0.6			0.7	0.1		0.2
		Percent		11.1	33.3			38.9	5.5		11.1

(1) Access to the tailpipe coupling nut is through the side panel covers which can only be opened after removal of the engine air inlet screen. The tailpipe must be supported during removal and installation.

(2) Physical location of the unit requires that the mechanic perform tasks with his arm stretched overhead, which is awkward and tiring. The weight of the unit (approximately 70 pounds) makes lowering and lifting it into place difficult. (Figure 46)

(3) The hydraulic pump-motor is attached to the APU housing studs with six nuts and washers. The top-most studs are inaccessible when the unit is installed. Special tools, fabricated at the local level, are necessary to remove and replace these nuts. (Figure 46)

TABLE XV - Continued

Component Code and Nomenclature		Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove / Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26010 Combining Transmission	Man-hr	7.6	1.1	0.2	1.4	1.2	3.8	0.5		0.4
	Percent		14.r	2.6	18.4	15.8	36.8	6.6		5.3
	Note		(4,5		(2)	(3)	(1)			(6)

(1) Must disconnect number seven synchronizing shaft from forward output quill and number eight synchronizing shaft from aft output quill of combining transmission.

(2) Must remove two engine shafts which input to combining transmission on left-and right-hand sides of transmission.

(3) Must remove numerous elbows, reducers, unions, etc., from old transmission and install on replacement transmission. New packings or O-rings are used at each transferred fitting.

(4) Internal failures are usually detected when in incipient stage via spectographic oil and analysis program (SOAP) samples. When transmission becomes suspect it is drained, refilled, and placed on a reduced inspection interval schedule. This is a worthwhile procedure, but it is time-consuming.

(5) In order to remove each of three filter disc packs for inspection and/or cleaning, the oil tank must be drained to a level below the filter, an oil hose must be disconnected from the filter housing, and four nuts which retain the filter housing to the combining transmission must be removed. (Figure 47)

(6) Must conduct rotor phase check each time components of the drive system are removed or disconnected.

TABLE XV - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove/ Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
26012	Synchronizing Shaft Assembly	Man-Hr	2.4	0.4	0.1			1.0	0.2	0.5	0.2
		Percent		16.7	4.2			41.7	8.3	20.8	8.7
26013	Aft Trans-mission Assembly	Man-Hr	42.6	0.8	0.4	4.5	2.5	26.7	0.5	0.5	0.5
		Percent		1.9	0.9	10.6	5.9	62.7	1.2	1.2	15.7
		Note		(5)		(1,2)	(3)	(4)			(6,7)

(1) Many accessories are driven by, and located on, the aft transmission assembly. In order to provide sufficient clearance for transmission removal both electric generators must be removed. Each generator is secured to the transmission via 8 nuts on studs. Cumbersome "crow's foot" type wrenches are used to remove the nuts.

(2) Removal of armor plating is required on aircraft so equipped.

(3) Buildup of the replacement transmission requires transfer of the following components from the removed transmission: the fan drive adaptor and plate assembly, three hydraulic pumps, the hydraulic motor, and numerous reducers and unions for fluid lines.

(4) When raising replacement transmission into position and mating with lower end of the rotor shaft, great care must be exercised to prevent damage to the transmission output seal. As a precaution, the seal and seal retainer are removed from the transmission, carefully worked onto the lower end of the rotor shaft and finally reattached to the transmission housing as the transmission is raised higher. (Figure 40)

(5) Refer to 26010 Combining Transmission Assembly, Note 4.

(6) Refer to 26010 Combining Transmission Assembly, Note 6.

(7) Transmission mount bolts must be retorqued 25 flight hours after installation.

TABLE XV - Continued

Component Code and Nomenclature			Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspec. And Test
26016	Forward Transmission Assembly	Man-Hr	39.0	1.1	1.5	10.2	6.7	12.4	0.2		6.9
		Percent		2.8	3.8	26.2	17.2	31.8	0.5		17.7
		Note		(5)		(1,2)	(3)	(4)			(6,7)

(1) Due to the arrangement (physical location) of components in the power delivery train to the forward rotor, the rotor blades, the number one and number two synchronizing shafts, and the speed trim actuator yoke assy. must be removed to provide access for removal of the forward transmission.

(2) Removal of armor plating is required on aircraft so equipped.

(3) Buildup of replacement forward transmission requires transfer of following components from removed transmission: rotor head, rain shield, swashplate, flight controls actuating cylinders, rotor tach generator, and numerous elbows and reducers for oil lines.

(4) Each time either the forward transmission or the adapter and plate assy. is replaced, the adapter keys must be custom indexed and drilled to receive a retaining bolt. This process is time-consuming and must be performed by a relatively highly skilled mechanic. (Figures 49 and 50)

(5) Refer to Combining 26010 Transmission Assembly, note 4.

(6) Refer to Combining 26010 Transmission Assembly, note 6.

(7) The mount bolts for the forward transmission assy. must be retorqued 25 flight hours after installation.

TABLE XV - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26017	Engine Transmission Assembly	Man-Hr	4.5	0.4	0.5	0.6	0.4	2.2	0.1		0.3
		Percent		8.9	11.1	13.3	8.9	48.9	2.2		6.7
		Note		(2)	(1)						
26019	Transmission Shaft Assy.	Man-Hr	2.1	0.2	0.6			0.9	0.2		0.2
		Percent		9.5	28.6			42.9	9.5		9.5
26038	Aft Rotor Drive Shaft	Man-Hr	19.7	0.4	0.4	8.6	0.2	5.0	0.1	0.5	4.5
		Percent		2.0	2.0	43.8	1.0	25.4	0.5	2.5	22.0
		Note				(3)					(4,5)
26084	Adapter Assembly Rotor Drive	Man-Hr	2.2	0.2		1.5		0.5			
		Percent		9.1		68.2		22.7			
		Note				(1)					

(1) Difficulty is sometimes encountered when attempting to align the barrel nuts into which the engine transmission fairing retaining bolts thread. If not properly aligned, the bolts will cross thread in the nuts. (Figure 51)

(2) Refer to 26010 Combining Transmission Assembly, Note 4.

(3) Removal of three rotor blades, aft rotor head, and controllable swashplate is required for replacement of the aft rotor drive shaft assy.

(4) The mount bolts for the aft rotor drive shaft assy. must be retorqued 25 flight hours after installation.

(5) Refer to 26010 Combining Transmission Assembly, Note 6.

TABLE XV - Continued

Component Code and Nomenclature			Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26006	Output Seal-Aft Transmission	Man-Hr	15.0	0.3	0.4	12.4		1.9			
		Percent		2.0	2.7	82.7		12.6			
		Note				(2)					
26173	Chip Detector (Engine Trans.)	Man-Hr	1.1	0.2	0.5			0.3	0.1		
		Percent		18.2	45.5			27.3	9.1		
		Note			(3)						
42054	AC Generator	Man-Hr	1.8	0.3	0.2	0.3		0.8			0.2
		Percent		16.7	11.1	16.7		44.4			11.1
		Note				(5)		(4)			
45011	Hydraulic Servo Cylinder	Man-Hr	3.7	0.5	0.5	0.3	0.3	1.0	0.3	0.3	0.5
		Percent		13.5	13.5	8.1	8.1	27.1	8.1	8.1	13.5

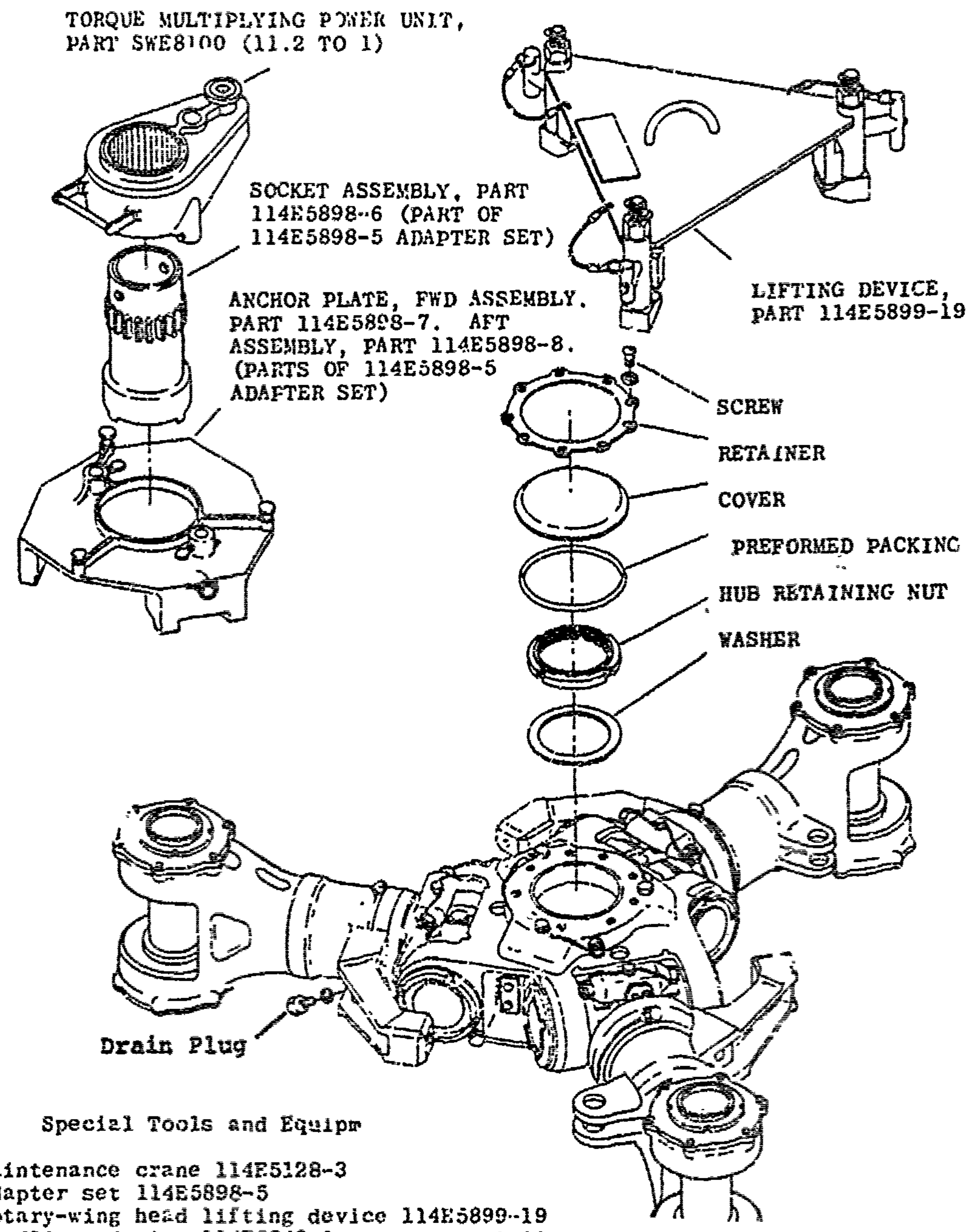
(1) The number eight synchronizing drive shaft must be removed to provide access to adapter assy.

(2) The output seal of the aft transmission seals against the lower end of the rotor shaft assy. Access to the seal requires removal of rotor blades, rotor head, swashplate, and the rotor drive shaft assy.

(3) Refer to 26017 Engine Transmission, Note 1.

(4) Two generators are mounted on the accessory gearbox on the aft transmission. The mounting arrangement consists of 8 nuts attaching the generator to studs in the gearbox housing. The top three studs and nuts are difficult to reach and are in close proximity to adjacent structure, restricting tool manipulation.

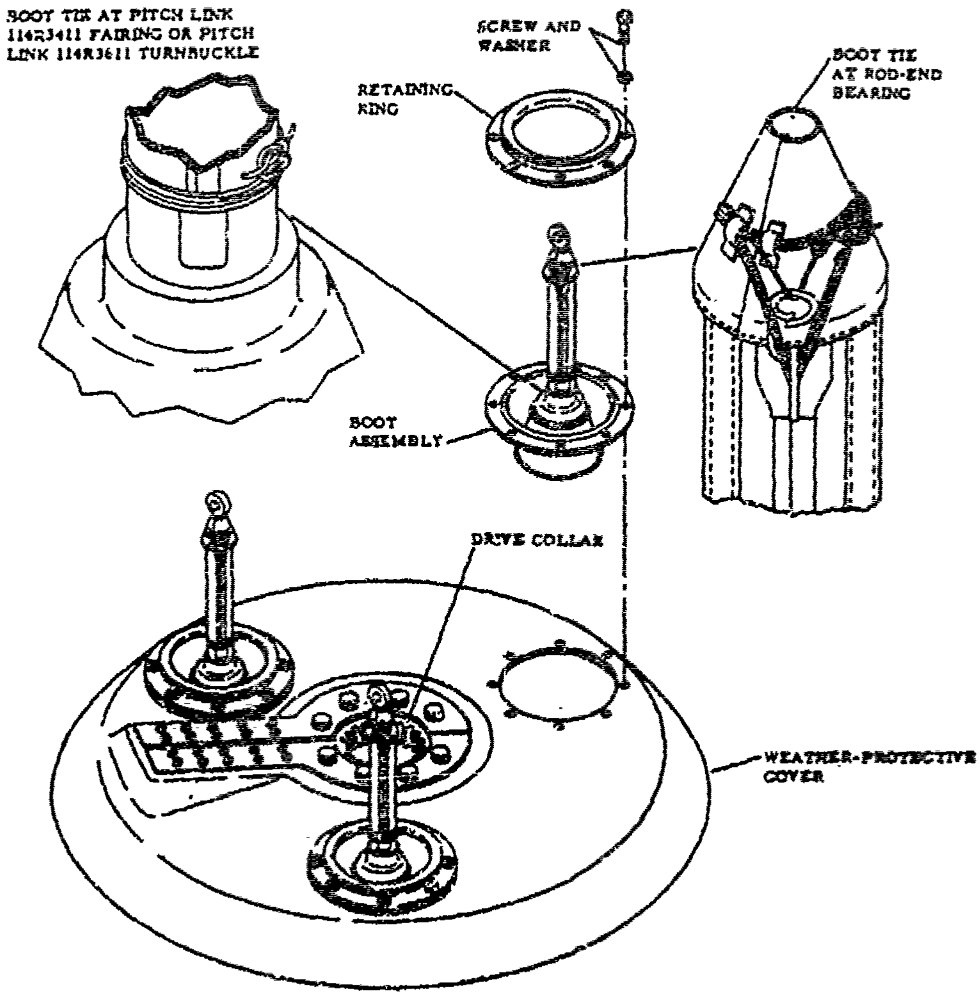
(5) When positioning the airscoop on the rear of the generator, the five attaching screws must be lockwired to the pmg terminal board mounting screws.



Special Tools and Equipm

Maintenance crane 114E5128-3
Adapter set 114E5898-5
Rotary-wing head lifting device 114E5899-19
Handling adapter 114E5840-1 or transportation skid 114G1020-38 or equivalent.
Torque wrench multiplier SWE8100
Torque wrench, 500 foot-pounds, 3/4-inch drive

Figure 42. Rotary-Wing Head Removal/Installation, CH-47 Helicopter.



Using a twine, Type P, Class 2, make a loop approximately 1 inch long. Make the short end of the twine at least 3 inches long. Make the longer end of the twine of sufficient length to make 4 to 5 wraps around the pitch link boot at the top edge of the lower zipper bulb.

Wrap the twine around the boot. Insert the longer end through the loop to form a slip knot. Then pull the twine taut. Continue wrapping the twine around the boot to make 4 to 5 wraps, pulling with sufficient tension to prevent the boot from shifting axially on the pitch link. Tie the longer end and the shorter end together with a double square knot.

Cut off excess twine approximately ½ inch from the knot.

Using twine, make three wraps around the boot cone through the loops. Pull the twine tight and secure it with a square knot. Continue the twine through the wire tab on the zipper, through the slot on the zipper slider, and then through the loops on the boot cone again. Pull the twine tight and secure it with a double square knot.

Cut off excess twine approximately ½ inch from the knot.

Figure 43. Weather-Protective Cover Boot Replacement, CH-47 Helicopter.

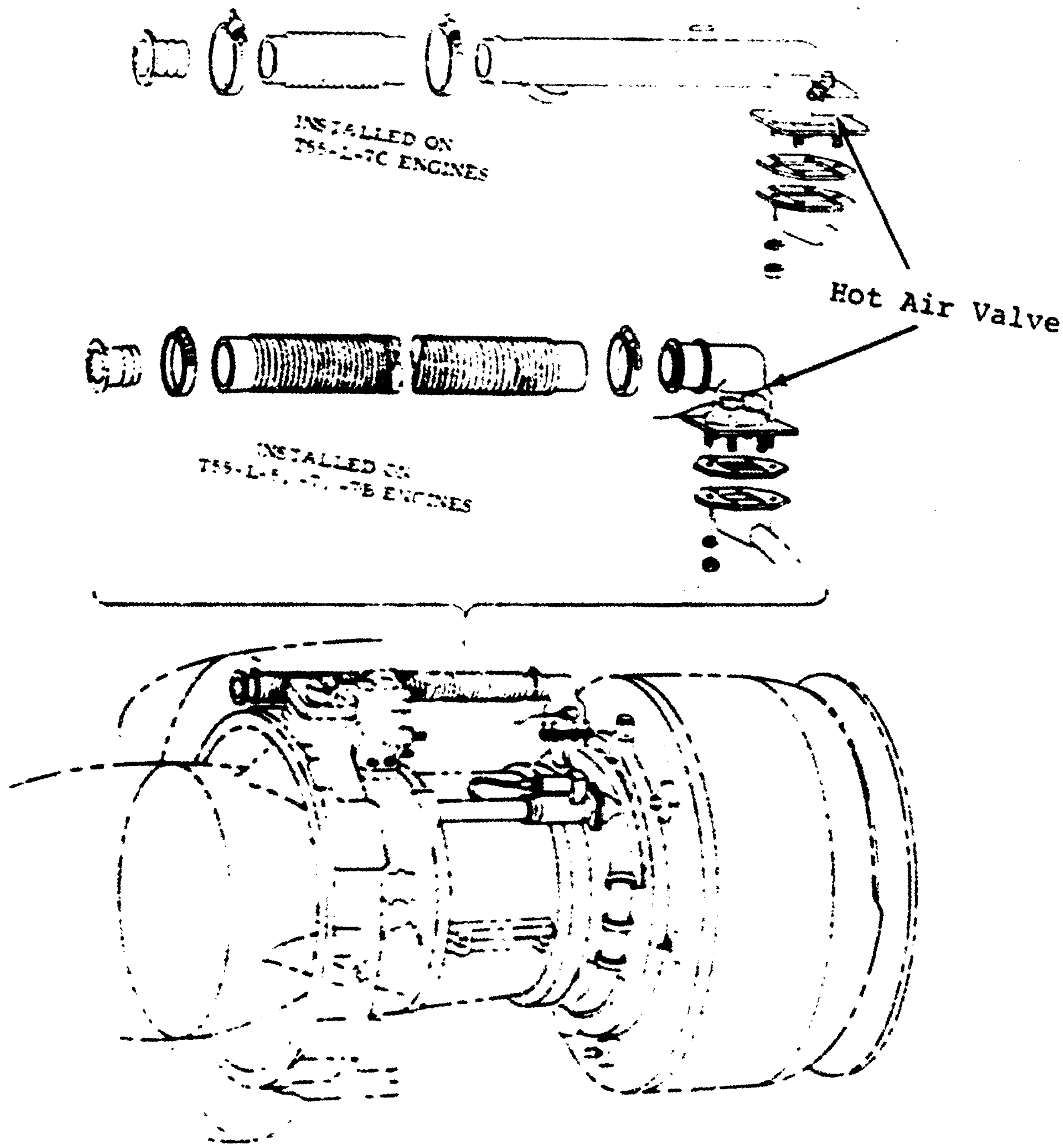


Figure 44. Engine Anti-Icing Installation, CH-47 Helicopter.

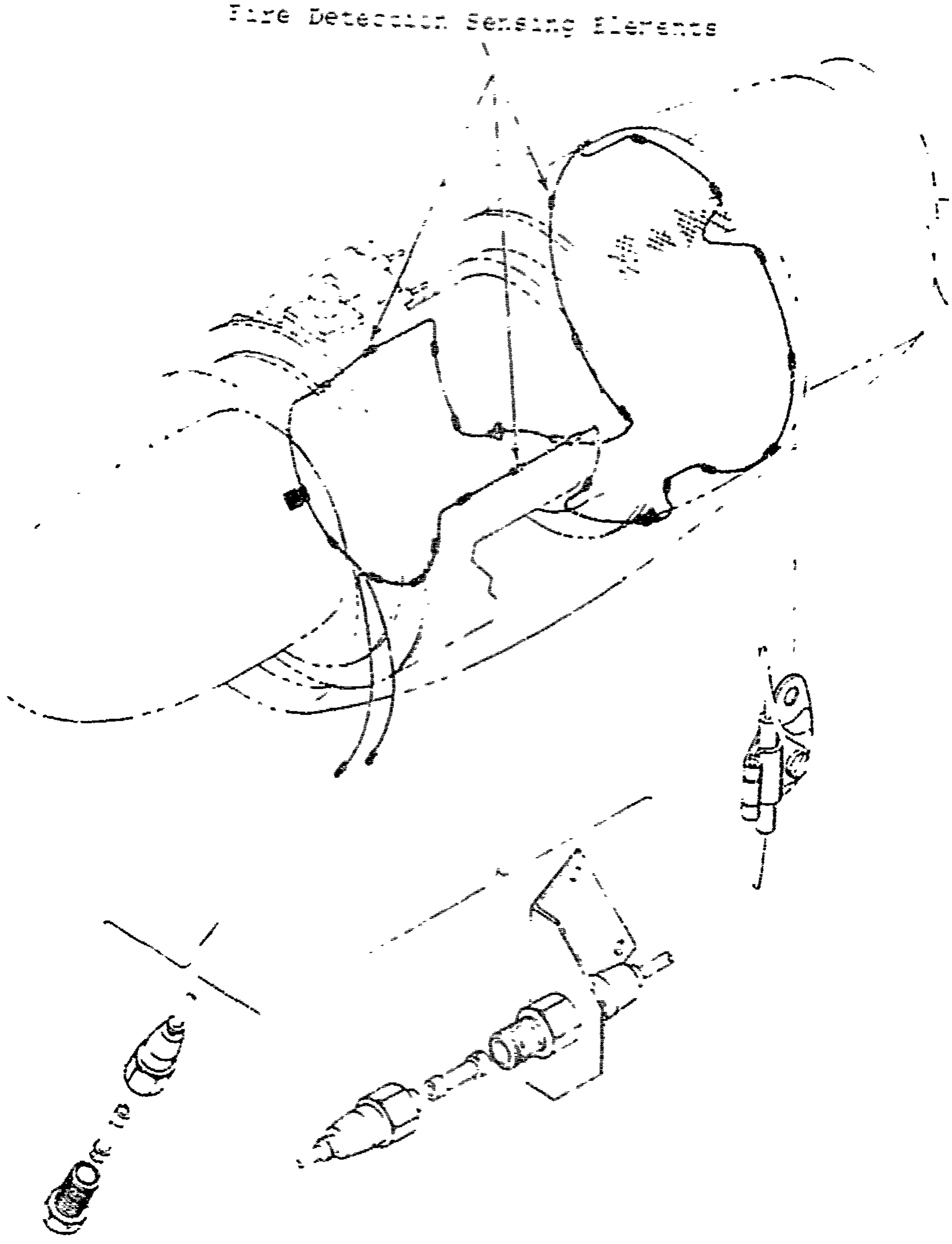


Figure 45. Engine Fire Detection Sensing Element Installation, CH-47 Helicopter.

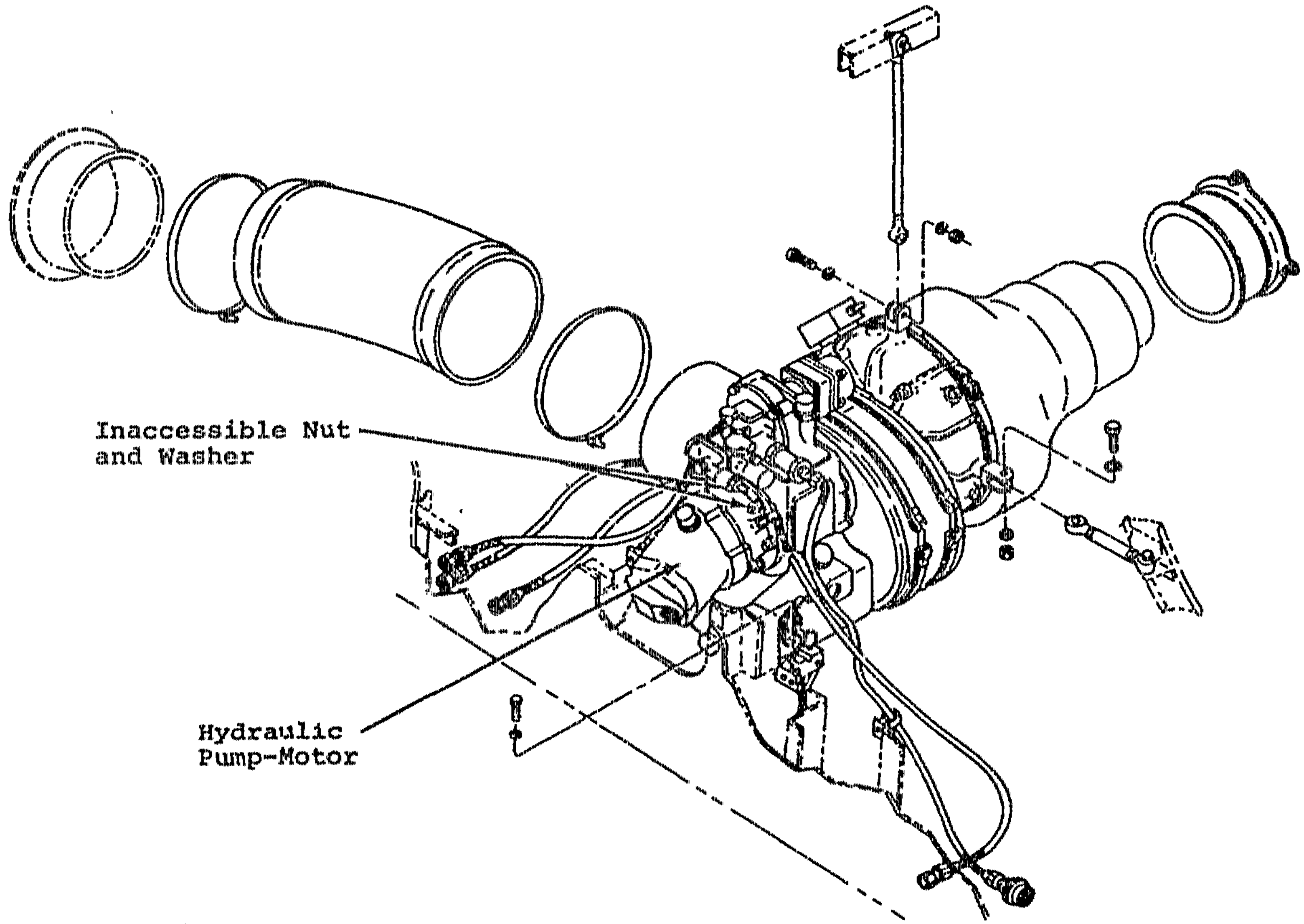


Figure 46. Auxiliary Power Unit Installation, CH-47 Helicopter.

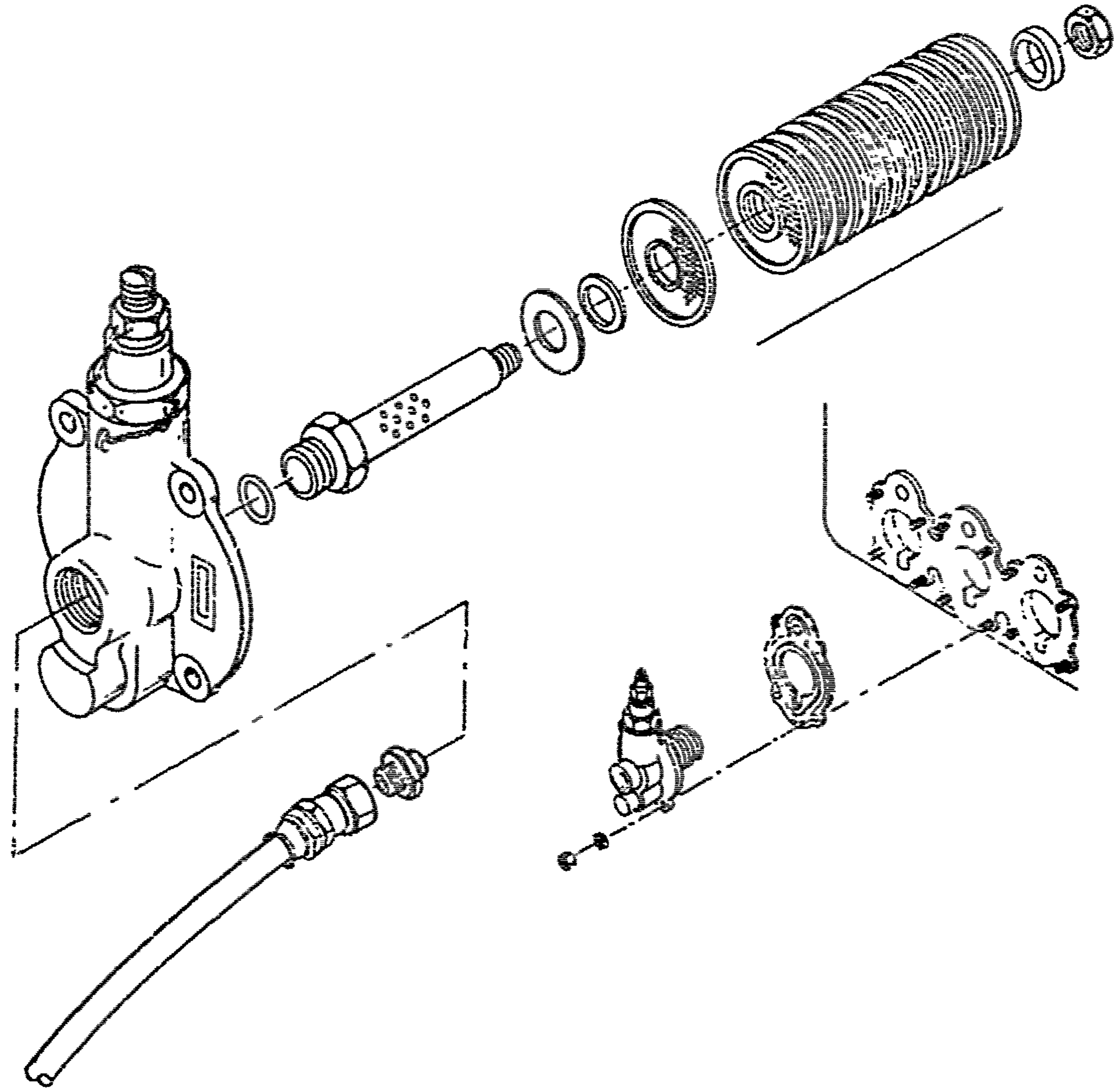


Figure 47. Filter Element Replacement, CH-47 Helicopter.

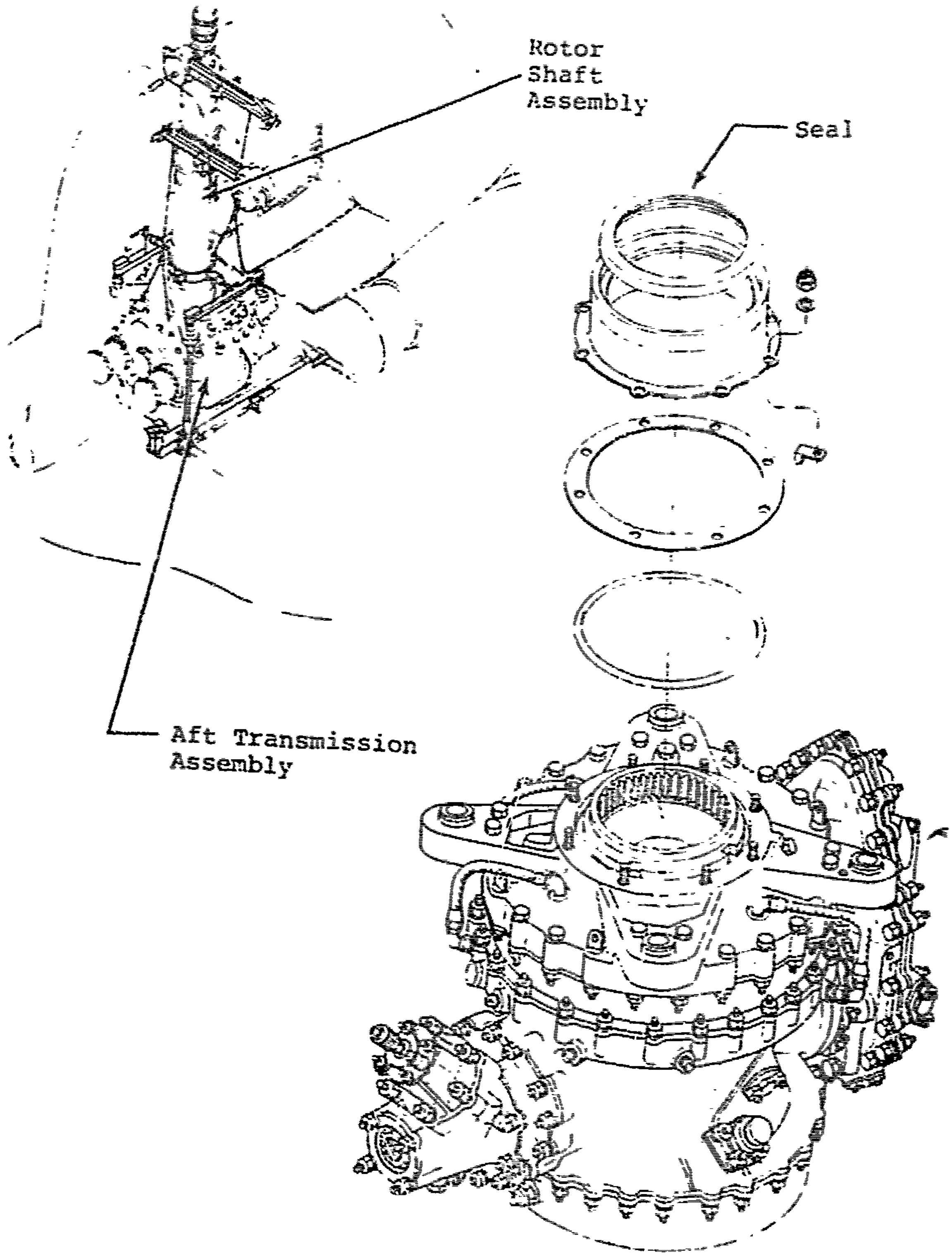


Figure 48. Mating of Transmission to Rotor Shaft, CH-47 Helicopter.

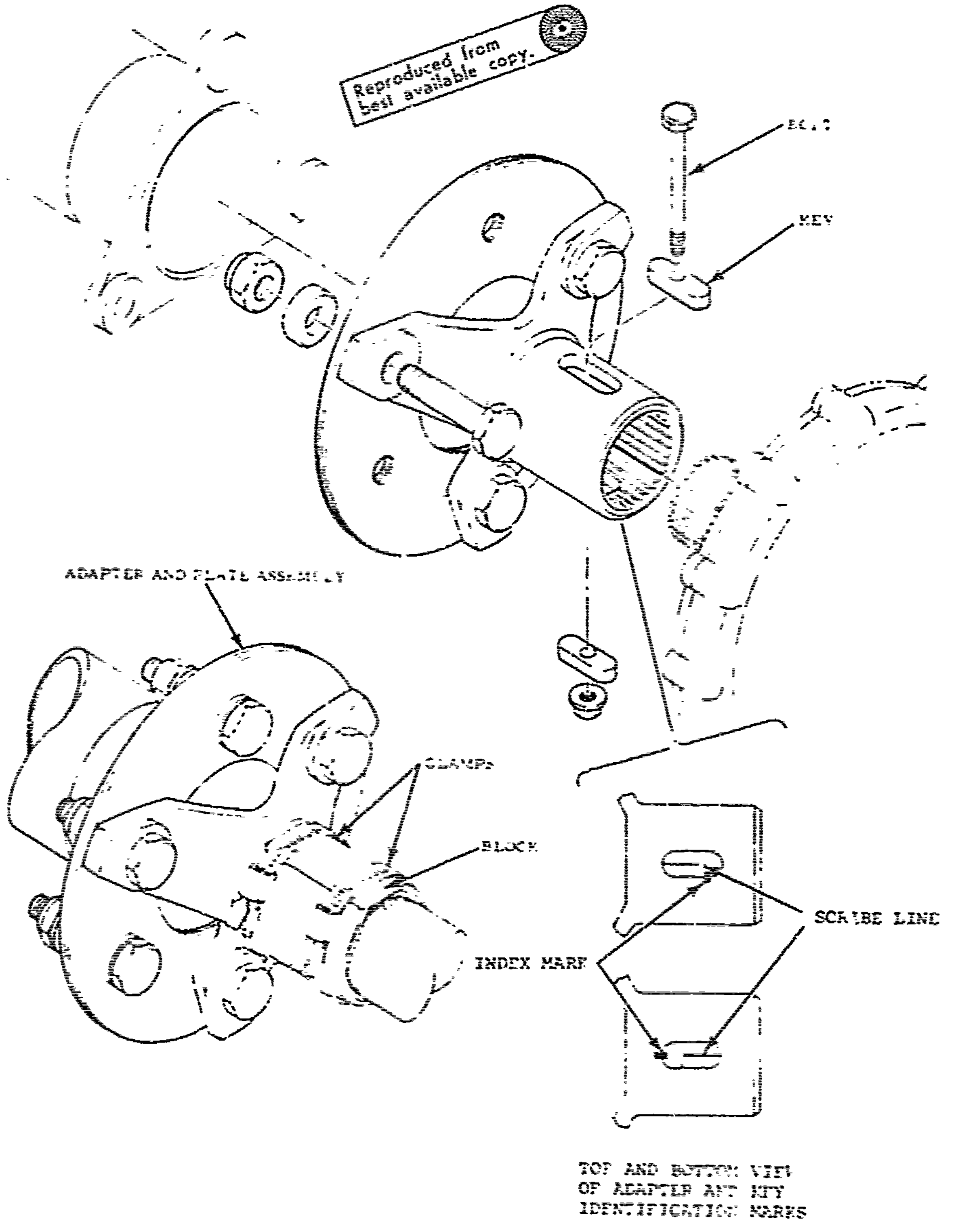
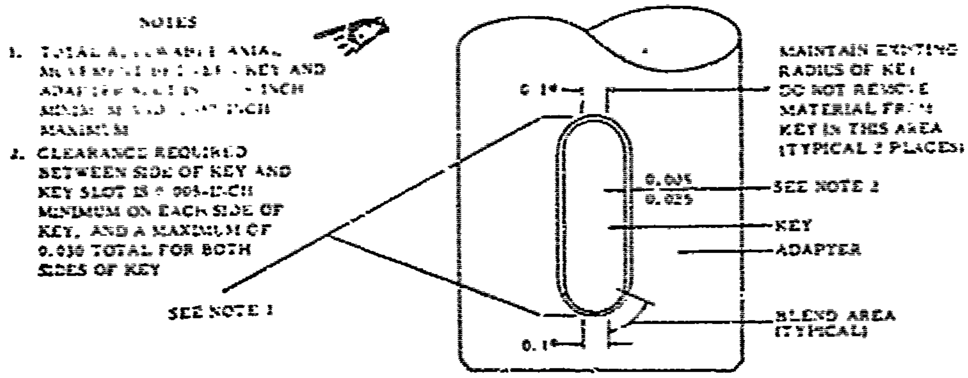


Figure 49. Drilling and Indexing Adapter Keys, Installation Hardware, CH-47 Helicopter.



(3) Place a new key (with the yellow scribe line outward) in one adapter hole. Shim it into the required position.

(4) Secure the key to the adapter. Use a wood or metal block and two hose clamps. Be sure the block is centered on the key.

(5) Obtain 2¼ inches of stainless steel tubing, 3/8-inch OD, 0.035-inch wall thickness. Insert it through the hole in the adapter and plate assembly and the holes in the shaft until it touches the key in the other side of the adapter.

(6) Drill a 19/64-inch hole in the key, using the tubing as a brushing. Use an extension drill. Remove the tubing. Enlarge the pilot hole in the key to 0.375-inch. Use an extension drill.

(7) Drill the remaining key in the same manner. Hold the previously drilled key in place with the hose clamps.

(8) Remove the hose clamps and block while holding the keys in place.

(9) Index each key in the adapter and plate assembly (4) to record its exact positioning in its hole. Matchmark each key and the adapter at different locations to ensure proper installation. Do not rely on the yellow scribe mark on the key.

(10) Remove the hose clamps and keys. Remove all burrs and chips from the adapter, splined shaft, and keys. Apply a light coat of grease on the key, in the drilled hole in the key, and in the slot area of the adapter and plate assembly. Reinstall the keys into the same holes and in the same position in which they were drilled.

(11) Secure the keys and adapter with the bolt (2) and a new locknut. Torque the nut to 100 to 125 pound-inches.

Caution

> Do not use the tools to fit the bolt or the keys in the adapter and plate assembly. The fit should be easy. Forcing the bolt or keys could cause helicopter vibration and damage to components.

(12) Check for a 0.005-inch to 0.025-inch clearance between each side of the key and the adapter slot side. The sum of the clearances on both sides must not exceed 0.030-inch. If the clearance is less than required, proceed as follows:

(a) Remove the bolt (2), nut, and the keys from the adapter.

(b) Hand file the side of the key as necessary to obtain the required clearances. Work the blend area as shown in illustration. The surface of the key must be smooth and free from nicks and gouges. Do not work the ends of the keys in an area approximately 0.19 inch at the center of the radii.

(c) After revowk, apply a light coat of grease to the key and key slot area before installation.

(d) Reinstall the keys, noting the matchmarks. Secure them with the bolt (2) and nut. Torque the nut to 100 to 125 pound-inches.

Figure 50. Drilling and Indexing Adapter Keys, Instructions, CH-47 Helicopter.

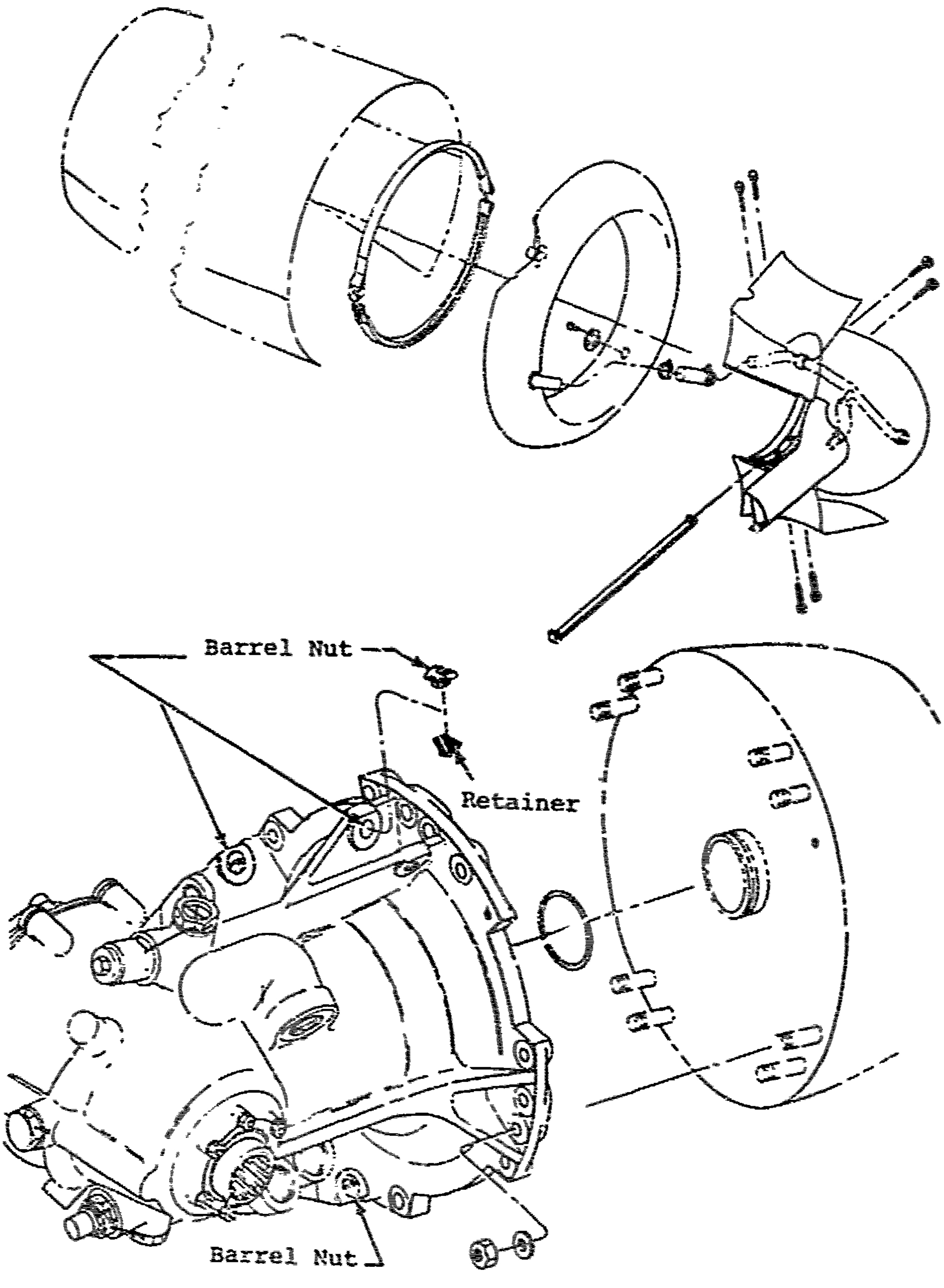


Figure 51. Barrel Nut Alignment, CH-47 Helicopter.

SUMMARY OF DESIGN FACTORS RELATED TO MAJOR COMPONENT REPLACEMENT, CH-47 HELICOPTER

The more significant maintainability design characteristics of the CH-47 helicopter, within the ten major component areas covered by the study, are in summary:

1. Main Rotor Hub

   a. A number of special tools and equipment are needed to replace either the forward or aft rotary-wing head assembly. The setup, use and teardown of these items contribute significantly to the maintenance time.

   b. Draining oil from the bearing oil tank and pitch varying housing is difficult due to the lack of space below the drain plug in which to place a container. The oil must be diverted outboard by a tray or chute to the container.

   c. The method of attaching the boot at the pitch link fairing or turnbuckle and at the rod-end bearing involves wrapping and tieing twine around the boot. The procedure is somewhat involved and requires dexterity to insure a proper tie.

   d. The spring droop stop contains several small detail parts including washers, a bearing and springs. Care is required during disassembly to prevent loss of parts. The maintenance procedure specifies that the bolt be temporarily installed through the limiters, spring, washers and bearing to prevent such loss.

   e. The replacement of the fixed droop stop requires rotating the rotary-wing head until the blade is centered over the fuselage walkway, restraining the other blades to prevent rotating the head, and lifting and supporting the blade so that the droop stop is clear of the hub. The process is somewhat involved and is time-consuming.

2. Auxiliary Power Plant

   a. Physical location of the APU requires that the mechanic perform tasks with his arms stretched overhead, which is awkward and tiring. The weight of the unit makes lowering and lifting it into place difficult.

b. The top-most hardware attaching the hydraulic pump-motor to the APU housing is inaccessible when the unit is installed. Special tools, fabricated at the local level, are necessary to remove and replace this hardware.

3. Transmissions and Gearboxes

a. Replacement of the combining transmission requires disconnecting the number seven synchronizing shaft from the forward output quill and the number eight synchronizing shaft from the aft output quill.

b. Replacement of the combining transmission includes removing numerous elbows, reducers, unions, etc., from the old transmission and installing them on the replacement transmission. New packings or O-rings are used at each transferred fitting.

c. Internal failures are usually detected when in an incipient stage via spectographic oil analysis program (SOAP) samples. When the transmission becomes suspect, it is drained, refilled and placed on a reduced-inspection-interval schedule. This is a worthwhile procedure, but it is time-consuming.

d. In order to remove each of the three filter disc packs on the combining transmission for inspection and/or cleaning, the oil tank must be drained to a level below the filter, an oil hose disconnected from the filter housing, and four nuts which retain the filter housing to the combining transmission removed.

e. Many accessories are driven by, and located on, the aft transmission assembly. In order to provide sufficient clearance for transmission removal, both electric generators must be removed. Each generator is secured via eight nuts on studs. Cumbersome "crows foot" type wrenches are used to remove the nuts.

f. Removal of the armor plating, on aircraft so equipped, is required to gain access for replacement of the forward and aft transmission assembly.

g. Buildup of the replacement aft transmission requires transfer of the following components from the removed transmission: the fan drive adapter and plate assembly, three hydraulic pumps, the hydraulic motor, and numerous reducers and unions for fluid lines.

h. When raising the replacement aft transmission into position and mating with the lower end of the rotor shaft, great care must be exercised to prevent damage to the transmission output seal. As a precaution, the seal and seal retainer are removed from the transmission, carefully worked onto the lower end of the rotor shaft, and finally reattached to the transmission housing as the transmission is elevated.

i. Each time either the forward transmission or the adapter and plate assembly is replace, the adapter keys must be custom indexed and drilled to receive a retaining bolt. This process is time-consuming and must be performed by a relatively highly skilled mechanic.

4. Swashplate and Supporting Assemblies

a. A large portion of the total maintenance time is required for removal and installation of other components.

5. Main Drive Shaft

a. Removal of three rotor blades, aft rotor head, and controllable swashplate is required for replacement of the aft rotor drive shaft assembly.

6. Power Plant Installation

a. The major man-hour consumer is off-aircraft tear-down and buildup. Numerous plumbing lines in proximity to one another and to various engine accessories contribute to chafing problems and restrict access for accessory replacement and engine adjustment.

b. The fire detection sensing element is a wire enclosed in and insulated from a thin metallic tube. Each engine has three elements which are routed around the engine behind plumbing lines and engine components. The installation, coupled with the need to avoid crushing the fragile element, makes replacement difficult.

c. The fuel distributor and dump valve is located at the rear of the engine in the six o'clock position. Sequential disassembly and attachment of the fuel lines are necessitated by the proximity of the fittings.

d. The installation of the engine oil pump is such that the fuel purifier or fuel boost pump, and the gas producer tach generator, must be removed to replace the oil pump.

e. The flange on the anti-icing fairing hot-air valve has studs mounted in a downward direction, which hampers removal and installation of the attaching nuts.

f. The maintenance crane provided for removal of engines, transmissions and rotor components is difficult to assemble and disassemble and to operate. Overhead cranes or vehicle wreckers are frequently used in lieu of the crane.

TABLE XVI. COMPONENT REPLACEMENT DATA, CH-54 HELICOPTER

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove / Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
				Task Element							
15006	Tail Rotor Blade	Man-Hr	2.9	0.8				1.5		0.3	0.3
		Percent		27.7				51.7		10.3	10.3
15007	Main Rotor Head Assy.	Man-Hr	28.7	1.1		19.6		4.7	0.8	1.0	1.5
		Percent		3.8		68.3		16.4	2.8	3.5	5.2
		Note				(1)					
15016	Rotary Damper Assy.	Man-Hr	3.2	0.3				1.8	0.3		0.8
		Percent		9.4				56.2	9.4		25.0
		Note						(2,3)			

(1) Hub replacement requires removal of the six main rotor blades. The size of the blades and their distance from the ground requires at least three maintenance personnel. Several items of special support equipment are also required. (Figure 52)

(2) Sequential removal of the upper and lower brackets is required for proper removal and installation.

(3) The torque values differ for nuts attaching the upper bracket to the upper plate and the lower bracket to the lower plate. In addition, brackets with a flanged bushing and one curved side require another torque. Variation of torque values within an assembly tends to slow maintenance operations.

TABLE XVI - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
15021	Tail Rotor Head	Man-Hr	9.8	0.4		5.8		2.3	0.5	0.3	0.5
		Percent		4.1		59.2		23.5	5.1	3.1	5.1
		Note				(2,3)		(1,3)			
15079	Droop Restrainer	Man-Hr	1.5	0.3				1.0			0.2
		Percent		20.0				66.7			13.3
		Note						(4)			(5)
15208	Bearing Pitch Change Link	Man-Hr	1.4	0.3				0.5		0.3	0.3
		Percent		21.4				35.8		21.4	21.4

(1) When removing the links from the pitch change beam and sleeve brackets, each link must be color coded to the sleeve from which it was removed. This is necessary to ensure correct replacement.

(2) Component replacement includes removal and replacement of the four tail rotor blades, pitch change links and the pitch change beam.

(3) Several special tools are used during the component replacement process. (Figure 53)

(4) Replacement of the droop restrainer involves reassembling a number of detail parts. Care must be used to ensure correct assembly, especially proper orientation of the thrust washers located between the restrainer and clevis ears.

(5) The droop angle is measured with a standard propeller protractor. The angle is adjusted by stacking washers in the assembly.

TABLE XVI - Continued

Component Code and Nomenclature			Task Element								
			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon-ents	Remove/ Install Buildup Items	Remove / Install Compon-ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22005	Engine	Man-Hr	52.8	1.0		4.6	40.0	6.2			1.0
		Percent		1.9		8.7	75.8	11.7			1.9
		Note				(1)	(3)	(2)			
22028	Tailpipe Assembly	Man-Hr	1.8	0.3				1.5			
		Percent		16.7				83.3			
		Note						(4)			

(1) When replacing the engine a large segment of the total maintenance effort is devoted to removing and installing other components. These components include the engine air inlet particle separator and engine drive shaft. In particular, removing the drive shaft, which is attached by nine bolts at the rear of the engine, is difficult. A special tool is required and access to the attaching bolts is limited by the drive shaft sleeve.

(2) The No. 1 engine which is mounted lower to the engine deck, requires more time to replace. Difficulty is encountered in detaching and attaching the many connectors because of their proximity to the engine deck and lower portion of engine. (Figure 54)

(3) Teardown and buildup of accessories represents the largest single element of the replacement task. Many steps, involving disassembly and reassembly of engine accessories in prescribed sequence are involved in the engine buildup and teardown process.

(4) On the No. 1 engine the tail pipe exhaust is oriented upward and outboard 10° from horizontal centerline of engine. This is obtained by aligning the weld with the eleventh bolt hole on the engine, starting with top bolt hole and counting in a clockwise direction. On No. 2 engine the orientation of the tailpipe exhaust is directly away from the helicopter. This is obtained by aligning the weld with the tenth bolt hole on the engine, starting with top bolt hole and counting in a counterclockwise direction. (Figure 55)

TABLE XVI - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/Install Other Components	Remove/Install Buildup Items	Remove/Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22037	Fuel Control	Man-Hr Percent Note	6.4	0.8 12.5			0.5 7.8	2.6 40.[illegible] (1)		0.5 7.8	2.0 31.3 (2)
22043	Particle Separator	Man-Hr Percent	5.5	0.4 7.4				4.3 78.2		0.3 5.5	0.5 9.0
22100	EAPS Blower	Man-Hr Percent	3.4	0.4 12.0			1.2 34.0	0.8 24.0	0.5 15.0		0.5 15.0
22113	Anti-Ice Valve	Man-Hr Percent	1.3	0.3 23.1				0.7 53.8			0.3 23.1
22150	Starter	Man-Hr Percent Note	2.6	0.3 11.5			0.3 11.5	1.4 53.8 (3)	0.1 3.9		0.5 19.3

(1) The fuel control for the No. 1 engine is mounted low and inboard, adjacent to the engine deck. This low mounting profile hinders access to plumbing lines and mounting hardware.

(2) After replacing the fuel control, an engine part-power check is performed. The preparation (attaching weights for hold down purpose) and the actual checking sequence normally requires two hours to accomplish.

(3) It is more difficult to disconnect and connect the hydraulic pressure and return lines for the starter mounted on the No. 2 engine. This is due primarily to its physical location in relation to engine deck and adjacent structure.

TABLE XVI - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove / Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
22399	Anti-Ice Sensor	Man-Hr	1.9	0.3				1.3			0.3
		Percent		15.8				68.4			15.8
24014	APP Engine	Man-Hr	6.4	0.4		1.5	1.8	1.9		0.3	0.5
		Percent		6.3		23.4	28.1	29.7		4.7	7.8
		Note					(2)	(1)			
24038	APP Clutch	Man-Hr	2.3	0.3		0.8	0.7				0.5
		Percent		13.0		35.0	30.0				22.0
		Note				(3)					
24090	APP Fuel Control	Man-Hr	3.4	0.8		1.3	1.0				0.3
		Percent		24.0		38.0	29.0				9.0
		Note				(4)					

(1) In addition to disconnecting fuel lines, vent lines, hydraulic lines and drain lines, replacement includes removing and installing a number of fittings, brackets, support struts and associated hardware. (Figure 56)

(2) The teardown of the removed APP engine, and buildup of the replacement engine includes removing and installing the adapter, tailpipe, starter, support assy. and attaching hardware. (Figure 57)

(3) To replace the APP clutch, the APP Drive shaft must be removed and reinstalled. This task involves disconnecting and attaching the drive shaft at the clutch and the drive shaft at the APP flange. Each end of the shaft is attached by three bolts, washers and nuts.

(4) The replacement includes the teardown and buildup of the start fuel solenoid valve, main fuel solenoid valve, fuel inlet filter, fuel pressure switch and packings.

TABLE XV' - Continued

Component Code and Nomenclature		Total	Task Element							
			Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
24159 APP Starter	Man-Hr	3.1	1.8			0.3	0.6	0.1		0.3
	Percent		58.0			10.0	19.0	3.0		10.0
24187 APP Fuel Pump	Man-Hr	4.4	1.5		2.2		0.4			0.3
	Percent		34.0		50.0		9.0			7.0
	Note				(1)					

(1) The fuel pump and the acceleration control assembly which are bolted together make up the fuel control assembly. To replace the fuel pump, the fuel control assembly must be removed from the drive pad of the APP accessory drive assembly.

TABLE XVI - Continued

Component Code and Nomenclature		Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
					Task Element					
26011 Main Transmission	Man-Hr	97.7	1.1		45.2	20.0	24.0	3.2	2.2	2.0
	Percent		1.1		46.3	20.5	24.6	3.3	2.3	2.0
	Note				(1)	(5,6)	(2,3,4)	(7)		

(1) Due to the arrangement (physical location) of components in the power delivery train to the rotors, many components must be removed to provide access to the transmission. These include main rotor blades, number one tail rotor drive shaft, APP drive shaft, APP fire detector, and both engine-to-transmission drive shafts. On newer "B" model aircraft, the engines must be moved forward to permit removal of engine-to-transmission drive shafts.

(2) The very size and weight of the transmission has an effect on replacement time. With rotor head installed, a 6,000-pound-capacity hoist is required.

(3) Transmission is secured to fuselage via twelve mounting bolts which thread into barrel nuts. Some difficulty is experienced aligning the nuts, and occasionally cross threading occurs.

(4) The contacting surface of the transmission flange on the mounting fittings must be sealed with sealing compound.

(5) Buildup of the replacement transmission requires transfer of the following components from the removed transmission: the main rotor head, oil cooler and support assy., oil cooler blower pulley, main rotor servos, main rotor brake, four hydraulic pumps, rotor tach generator, two AC generators, electric wiring harness and numerous lubrication lines.

(6) Alignment of the rotor brake package after transfer to the replacement transmission is difficult and time-consuming due primarily to its awkward position (under the brake disc).

(7) The capacity of the transmission oil system is 13 gallons. Filling the system from a 55 gallon drum using a hand pump takes a good deal of time, especially in cold ambient temperatures.

TABLE XVI - Continued

Component Code and Nomenclature			Task Element: Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26019	Tail Rotor Gearbox	Man-Hr	20.8	0.4		11.9		6.1	0.6	0.6	1.2
		Percent		1.9		57.2		29.3	2.9	2.9	5.8
		Note				(1)		(2)			
26029	Tail Rotor Drive Shaft Bearing	Man-Hr	4.7	0.3		2.8		0.8	0.8		
		Percent		6.4		59.6		17.0	17.0		
		Note				(3)					
26040	Main Input Seal (Main Transmission)	Man-Hr	9.2	0.8		5.5		2.4	0.5		
		Percent		8.7		59.8		26.1	5.4		
		Note				(4)					

(1) Replacement of tail rotor gearbox requires removal and reinstallation of rotary beacon support and the tail rotor assembly. Upon reinstallation, balance and track must be checked.

(2) The pylon drive shaft must be disconnected and supported. Flight controls are disconnected at input linkage.

(3) Adjacent tail rotor drive shafts must be removed for replacement of hanger bearings.

(4) Replacement of an input seal requires that the respective engine be moved forward to permit removal of the engine to transmission drive shaft.

TABLE XVI - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove / Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26042	Intermediate Gearbox	Man-Hr	7.1	1.1				4.4	0.7		0.9
		Percent		15.5				62.0	9.8		12.7
		Note						(1,2)			
26066	Oil Pump (Main Trans- mission)	Man-Hr	5.0	0.4				1.0	3.3		0.3
		Percent		8.0				20.0	66.0		6.0
		Note							(3)		
26083	Rotor Brake Seal (Main Transmission)	Man-Hr	7.1	0.5		4.0		2.2	0.3		
		Percent		7.1		56.3		32.4	4.2		
		Note				(4)		(5)			

(1) Adjacent tail rotor drive shafts must be disconnected and supported to prevent damage to the Thomas Couplings.

(2) The gearbox weighs approximately 250 pounds, but because of its location aft and below the tail rotor pylon, it cannot easily be reached by a hoist and therefore is usually man-handled off and on the aircraft.

(3) Oil system must be flushed if reason for pump replacement is internal failure. Flushing procedure involves: drain the system (13 gal.), replace filter, refill system, operate aircraft until normal operating temperature reached, drain oil and repeat procedure up to three times.

(4) The rotor brake package must be removed to provide access to the rotor brake shaft seal. Upon reinstallation, the brake package must be aligned by shimming. This process is difficult and time-consuming primarily due to the brakes awkward position under the brake disc.

(5) A spanner type locknut must be removed and reinstalled when replacing the rotor brake shaft seal. The torque requirement · the locknut is 400-500 ft. lbs, applied by a special socket. Due to the location the ai aft where this work must be accomplished, mechanics have two problems: (a) assu a work position from which the needed leverage can be exerted, and (b) maintaining engagem t of the special socket with the spanner nut. This is a two man operation which is difficult to perform while standing on tail work stands. (Figure 58)

TABLE XVI - Continued

Component Code and Nomenclature			Total	Task Element: Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove/ Install Buildup Items	Remove / Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
26112	Brake Disc (Main Transmission)	Man-Hr	3.9	0.3				1.0	0.8	1.2	0.6
		Percent		7.7				25.6	20.5	30.8	15.4
		Note								(1)	
26224	Tail Rotor Shaft Assy. (Number 1)	Man-Hr	2.6	0.3				1.4		0.9	
		Percent		11.5				53.8		34.7	
26260	Chip Detector (Tail Rotor Gearbox)	Man-Hr	1.6	0.3				0.8	0.5		
		Percent		18.8				50.0	31.3		
26329	Tail Rotor Shaft Assy. (Number 2-6)	Man-Hr	2.5	0.5			0.6	1.4			
		Percent		20.0			24.0	56.0			
42134	Generator	Man-Hr	2.0	0.3				1.2	0.1		0.4
		Percent		15.0				60.0	5.0		20.0
		Note						(2)			

(1) Replacement of the brake disc requires that the brake package assembly be removed. Upon reinstallation, the brake package must be aligned by shimming. This process is difficult and time consuming primarily due to the brake's awkward location under the brake disc.

(2) The installation includes preparing and applying a bead of compound around the outer periphery of the QAD mount to gearbox cover mating surfaces. This sealing process is required to prevent moisture entry.

TABLE XVI - Continued

Component Code and Nomenclature			Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Compon- ents	Remove/ Install Buildup Items	Remove/ Install Compon- ent	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
			Task Element								
45010	Main Rotor Servo Unit	Man-Hr	3.2	0.5			0.4	1.5	0.5		0.3
		Percent		15.6			12.5	46.9	15.6		9.4
		Note						(1,2)			
57027	AFCS Servo Unit	Man-Hr	7.1	0.8	0.5			3.7	0.6	0.5	1.0
		Percent		11.3	7.0			52.1	8.5	7.0	14.1
		Note						(3)	(4)		

(1) Replacement requires a torque reactor and wrench (special tools) to remove the trunnion bolt and nut attaching the servo to the trunnion on the stationary swashplate.

(2) During installation, proper shimming is necessary between the fork and the trunnion. When inserting these shims, special attention is required to ensure that the oil grooves of the shims are positioned toward the bearings.

(3) The unit located in the controls compartment behind the pilot's seat, is comprised of four separate banks of servo mechanisms. Assembled and installed in the helicopter, the package is conjested, restricting access to rods, linkage and attaching hardware.

(4) Draining the system is required for component replacement. This involves disconnecting fittings and drawing fluid into a container. Restricted access often causes spills and cleanup.

TABLE XVI - Continued

Component Code and Nomenclature		Task Element								
		Total	Fault Isolate	Gain Access And Secure	Remove/ Install Other Components	Remove / Install Buildup Items	Remove/ Install Component	Drain Lube Service	Adjust Align Track Etc.	Inspect And Test
57420 AFCS Amplifier	Man-Hr	1.1	0.5	0.1			0.2			0.3
	Percent		45.5	9.0			18.2			27.3
	Note		(2)				(1)			

(1) The AFCS Amplifier has 19 screws of two different lengths attaching the top cover to the component case. In addition to holding the cover in place, the screws also secure five cards in place within the box. The torquing of these screws causes fluxing of the cards, which results in damage to the card circuitry.

(2) Moisture entering the component is suspected of causing intermittent system operation. When this occurs it is difficult to troubleshoot the system. Normally the replacement procedure includes drying out the unit with a heat gun.

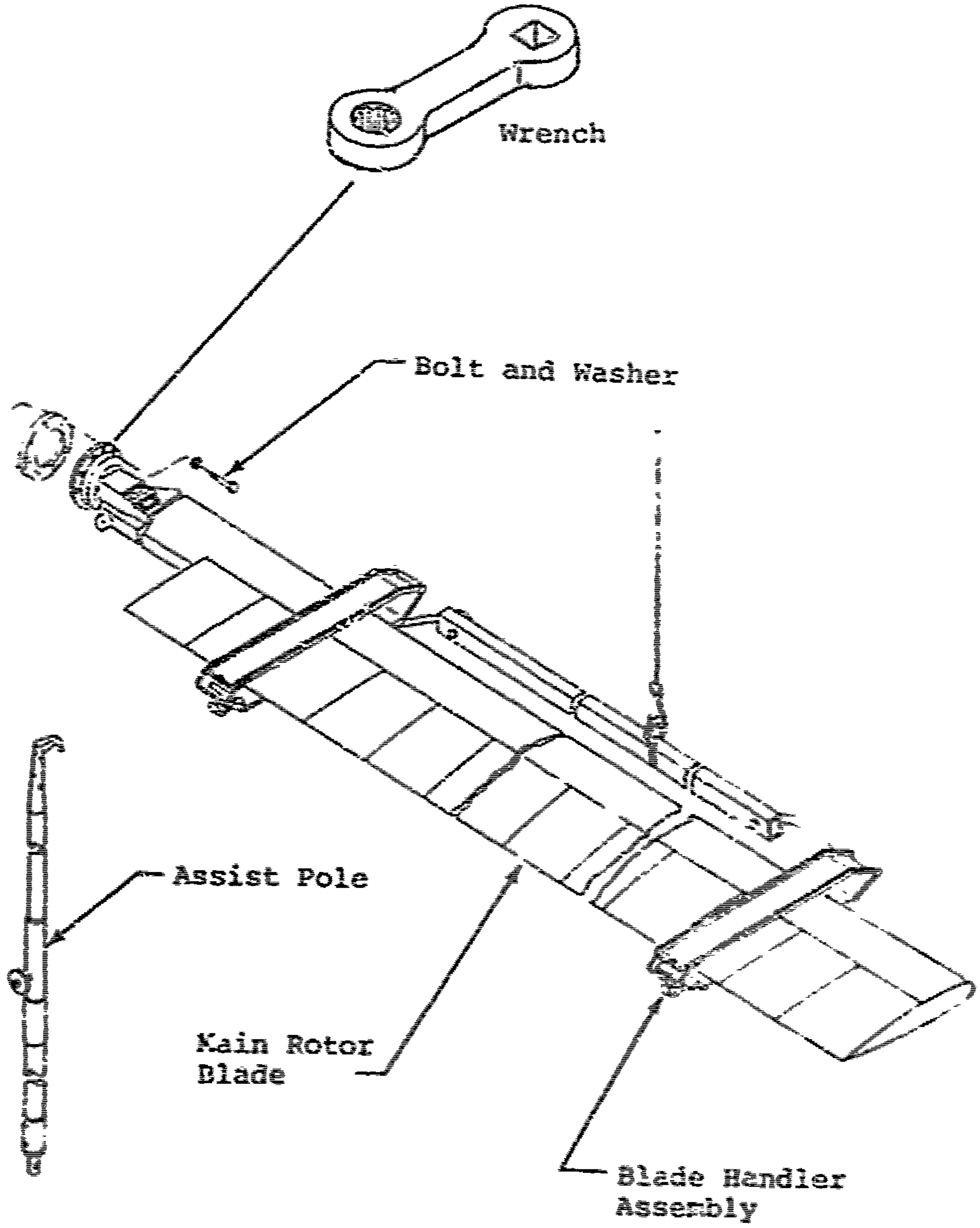


Figure 52. Main Rotor Blade Removal, CH-54 Helicopter.

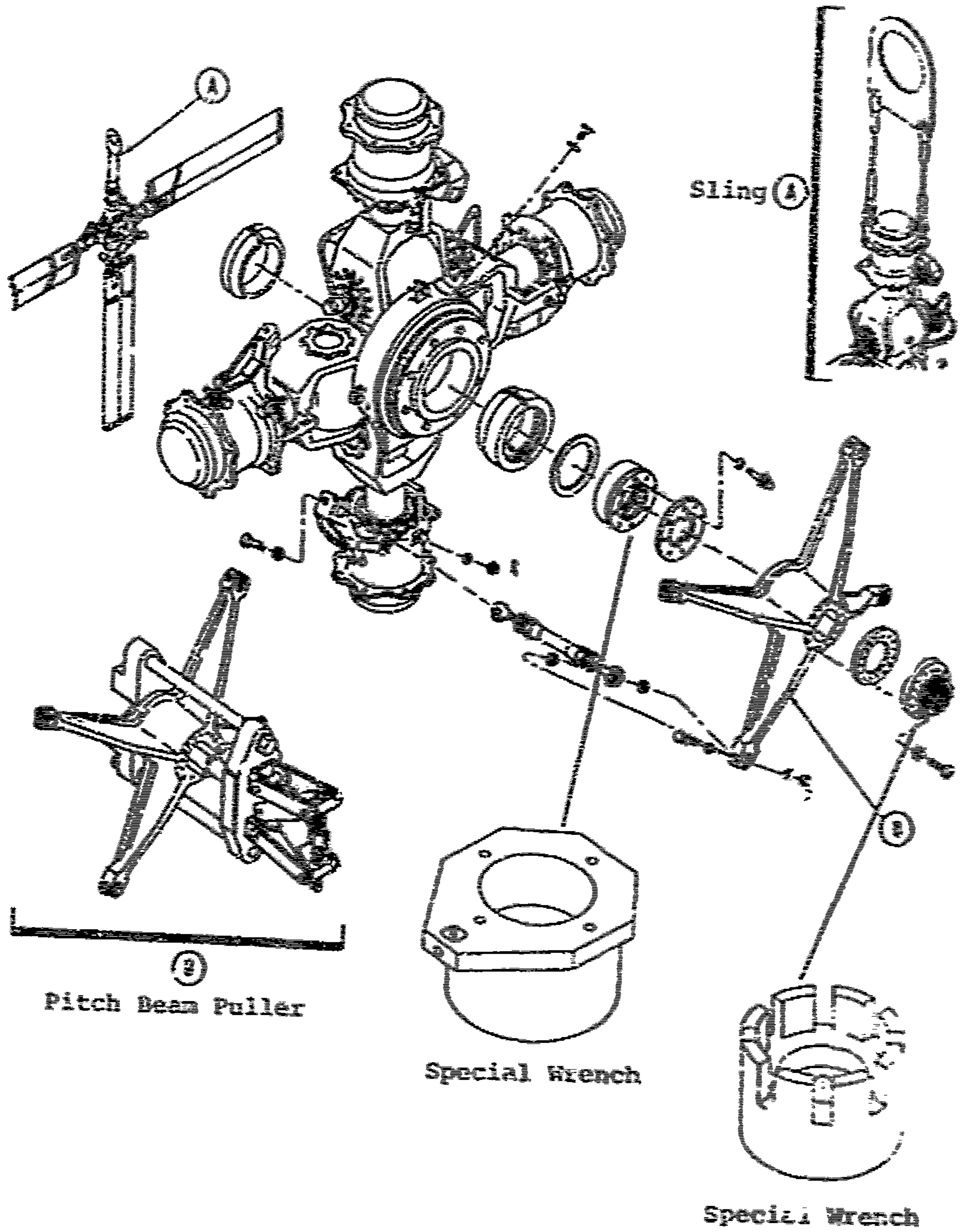


Figure 53. Tail Rotor Head Removal, CH-54 Helicopter.

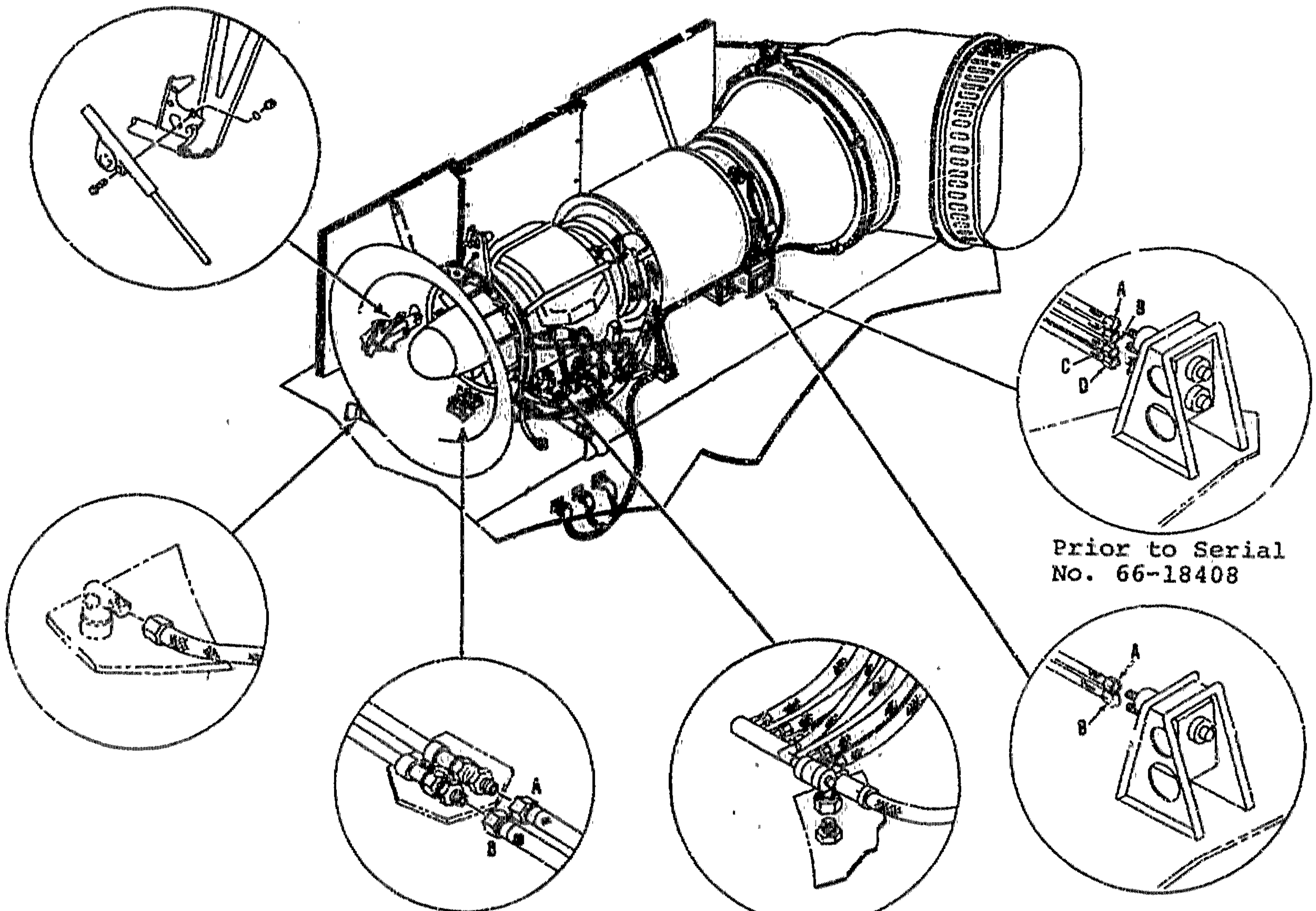


Figure 54. Engine Connections, CH-54 Helicopter.

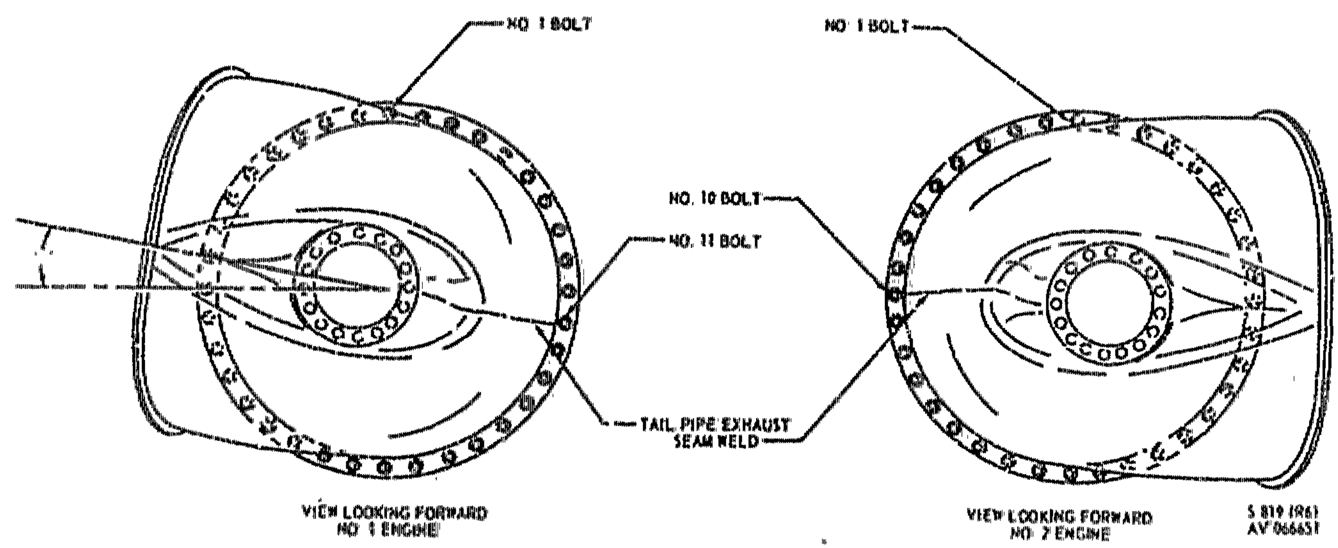


Figure 55. Tailpipe Exhaust Installation, CH-54 Helicopter.

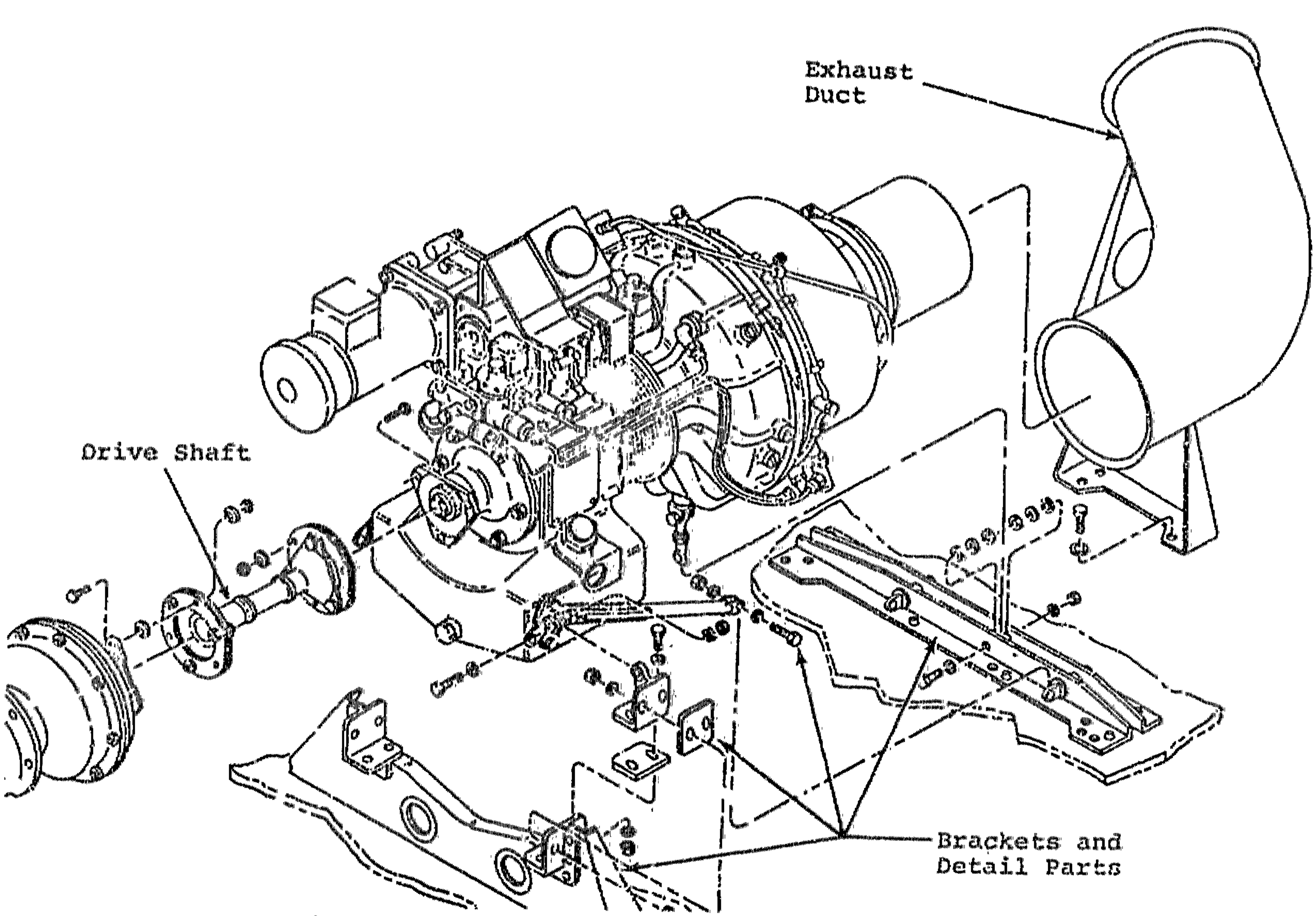


Figure 56. APP Installation, CH-54 Helicopter.

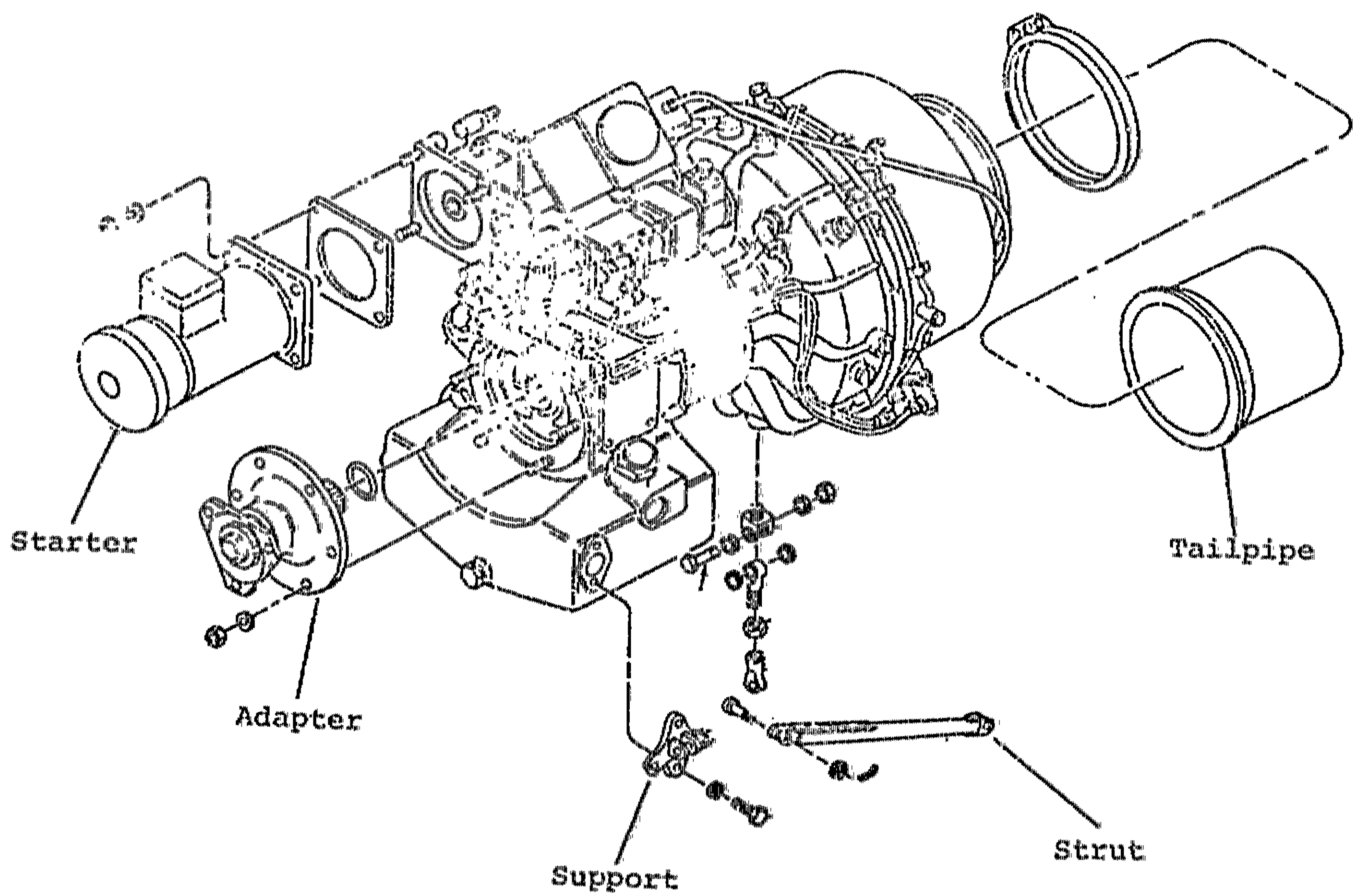


Figure 57. Removal/Installation of APP Components, CH-54 Helicopter.

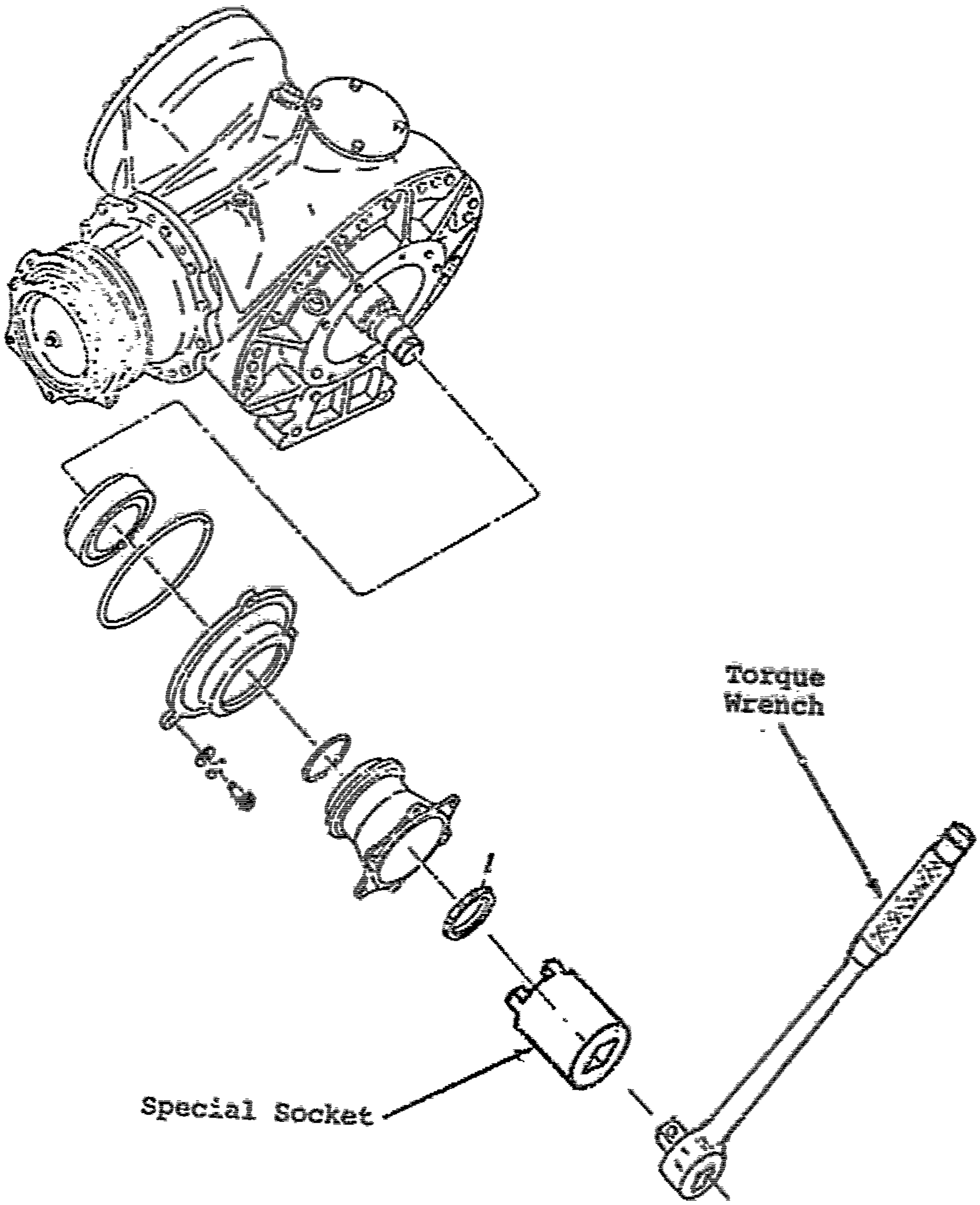


Figure 58. Removal/Installation of Face Slotted Spanner Nuts, CH-54 Helicopter.

SUMMARY OF DESIGN FACTORS RELATED TO MAJOR COMPONENT REPLACEMENTS, CH-54 HELICOPTER

The more significant maintainability design characteristics of the CH-54 helicopter, within the ten major component areas covered by the study, are in summary:

1. Tail Rotor System

   a. When removing the links from the pitch change beam and sleeve brackets, each link must be color coded to the sleeve from which it was removed. This is necessary to ensure correct replacement.

   b. Several special tools are used during the tail rotor head replacement process.

   c. The tail rotor head replacement includes removal and replacement of the four tail rotor blades, pitch change links and the pitch change beam.

2. Main Rotor Hub

   a. Hub replacement requires removal of the six main rotor blades. The size of the blades and their distance from the ground require at least three maintenance personnel. Several items of special support equipment are also required.

   b. Sequential removal of the upper and lower brackets is required for proper removal and installation of the rotary damper assembly.

   c. The torque valves differ for nuts attaching the upper bracket to the upper plate and the lower bracket to the lower plate of the rotary damper assembly. Some brackets require yet another torque. Variation of torque valves within an assembly tends to slow maintenance operations.

3. Auxiliary Power Plant

   a. The teardown of the removed APP engine and buildup of the replacement engine include removing and installing the adapter, tailpipe, starter, support assembly, and attaching hardware.

b. In addition to disconnecting fuel lines, vent lines, hydraulic lines and drain lines, replacement includes removing and installing a number of fittings, brackets, support struts and associated hardware.

c. To replace the APP clutch, the APP drive shaft must be removed and reinstalled. This task involves disconnecting and attaching the drive shaft at the clutch and at the APP flange. Each end of the shaft is attached by three bolts, washers and nuts.

d. The replacement of the APP fuel control includes the teardown and buildup of the starter fuel solenoid valve, main fuel solenoid valve, fuel inlet filter, fuel pressure switch and packings.

4. <u>Stability Augmentation System</u>

a. The AFCS servo unit, located in the controls compartment behind the pilot's seat, is composed of four separate banks of servo mechanisms. Assembled and installed in the helicopter, the package is congested, restricting access to rods, linkage and attaching hardware.

b. Draining the system is required for component replacement. This involves disconnecting fittings and draining fluid into a container. Restricted access often causes spills and cleanup.

c. The AFCS amplifier has 19 screws of two different lengths attaching the top cover to the component case. In addition to holding the cover in place, the screws also secure five cards in place within the box. The torquing of these screws causes flexing of the cards, which results in damage to the card circuitry.

5. <u>Transmissions and Gearboxes</u>

a. Due to the arrangement of components in the power delivery train to the rotors, many components must be removed to provide access to the main transmission.

b. The main transmission is secured to the fuselage via twelve mounting bolts which thread into barrel nuts. Some difficulty is experienced in aligning the nuts, and occasionally cross threading occurs.

c. The contacting surface of the main transmission flange on the mounting fittings must be sealed with sealing compound.

d. Buildup of the replacement main transmission requires transfer of a number of components from the removed transmission.

e. Alignment of the rotor brake package after transfer to the replacement transmission is difficult and time-consuming due primarily to its awkward position.

6. Power Plant Installation

a. When replacing the engine, a large segment of the total maintenance effort is devoted to removing and installing other components. These components include the engine air inlet particle separator and engine drive shaft. In particular, removing the drive shaft is difficult. A special tool is required and access to the attaching bolts is limited by the drive shaft sleeve.

b. On the No. 1 engine the tailpipe exhaust is oriented upward and outboard 10 degrees from the horizontal centerline of the engine. This is obtained by aligning the weld with the eleventh bolt hole on the engine, starting with the top bolt hole and counting in a clockwise direction. On No. 2 engine the orientation of the tailpipe exhaust is directly away from the helicopter. This is obtained by aligning the weld with the tenth bolt hole on the engine, starting with the top bolt hole and counting in a counterclockwise direction.

c. Teardown and buildup of accessories represent the largest single element of the replacement task. Many steps, involving disassembly and reassembly of engine accessories in prescribed sequence, are involved in the engine buildup and teardown process.

d. The No. 1 engine, which is mounted lower to the deck, requires more time to replace. Difficulty is encountered in detaching and attaching the many connectors because of their proximity to the engine deck and lower portion of engine.

e. The fuel control for the No. 1 engine is mounted low and inboard, adjacent to the engine deck. This low mounting profile hinders access to plumbing lines and mounting hardware.

MAINTAINABILITY CHECKLIST

The final requirement of this study was the preparation of a guide for use in technology reviews of future helicopter designs. A number of maintainability design guides have been published by the various military services over the years. These have been generally rather voluminous documents which cover maintainability in relatively great detail, addressing the subject mainly from the standpoint of qualitative characteristics. Often, such subjects as human factors and reliability are treated in the same text. Although none of the existing design guides are known to have been developed for helicopters specifically, many of the concepts in maintainability are equally pertinent to all types of hardware.

It was reasoned, therefore, that a guide for maintainability resulting from the work done in this study should not attempt to duplicate the already extensive material available on this subject. Moreover, the work accomplished and the knowledge gained from this program did not provide the basis for a "how to design" type of guide. Rather, it suggested a function-oriented guide to the maintenance factors deserving important consideration in the design of future helicopters. This, then, was the chosen approach.

The maintainability checklist presented in the following section accomplishes three purposes: (1) it shows the generic components of current-day helicopters which historically have been the greatest man-hour consumers in each of the major aircraft systems; (2) for each of these components, the elements of the replacement task contributing most to the man-hour requirement are shown; and (3) an index to the important factors in design related to each of the task elements is given.

The maintainability checklist developed here has a twofold application. It may be used by the designer of future helicopters to show the areas in which greatest attention is needed to effect improvements in maintainability. It may also be used by the purchaser of future aircraft as an aid in the design review process. Ideally, the checklist should not stand alone, but should eventually be integrated into a more comprehensive guide for maintainability.

The maintainability checklist presented in the pages which follow is organized in two parts. Part I, Task Elements,

lists the major components of each system which have ranked high in maintenance man-hour cost as shown by this study. The application of each component to the Army's current helicopter fleet is indicated. The elements of the component replacement task which contribute most to the maintenance time are listed. For each of these major task elements, an index to the pertinent design considerations is given.

Design Considerations, Part II, is a tabulation of the factors involved in maintenance task performance. It is not an all-inclusive list, necessarily, but does encompass those factors found most significant in terms of the objectives and scope of the present study. The design considerations are grouped into the eight task element categories used throughout the study.

Looking at the Engine Transmission Assembly (first item on page 8 of Part I), for example, it is observed that the most time-consuming elements in replacement of this component are removing and installing the item itself, removing other components and gaining access. The important design factors related to removal and installation of the component are contained in Section E of Part II, Items 1, 2, 5, and 14. Item 1 references the requirement for special tools and equipment, Item 2 the need to disconnect and reconnect electrical wiring, etc. In the category of removing other components, the reference is to Section C, Item 19, of Part II, which indicates that a drive shaft must be removed in order to replace the transmission. Using the checklist in this manner proceeds from the high man-hour components within each system to the several most time-consuming tasks involved in replacement of each component and, lastly, to a list of the important design factors related to each of the high task elements.

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS					Page 1
Component Nomenclature and Description	Current Application			Major Elements of Replacement Task	Design Considerations Index
	OH	UH/AH	CH		
Controls and Hydraulic Servo Actuators					
Collective Lever Assembly		X		Remove/Install Component	E 9,10,27
				Fault Isolate	A 1
				Inspect/Test	H 9
Collective/Cyclic Servo Actuators	X			Remove/Install Component	E 26
				Fault Isolate	A 15,19
				Inspect/Test	H 1
				Service	F 2
Cyclic Servo Actuators			X	Remove/Install Component	E 5,7,8,25,26
				Fault Isolate	A 1,12,15,16,20
				Access	B 4
				Inspect/Test	H 1,3,8
Flight Control Cylinder Valve		X		Remove/Install Component	E 5,16,25
				Fault Isolate	A 15,17,19,20
				Inspect/Test	H 1,2,3,5
				Adjust	G 3,6
				Access	B 4
Scissors/Sleeve Assembly		X		Other Components	C 2,4,5
				Remove/Install Components	E 10,16,27
				Fault Isolate	A 1,3,8

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS

Component Nomenclature and Description	Current Application OH	Current Application UH/AH	Current Application CH	Major Elements of Replacement Task	Design Considerations Index
Swashplate/Support Assembly	X	X		Other Components Remove/Install Component Fault Isolate	C 2,4,5,10,11,15 E 7,8,25,27,31 A 1,2,3,8,20
Swashplate			X	Other Components Remove/Install Component Adjust	C 1,2,3,12 E 1,16,27,31 G 1,10

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS

Component Nomenclature and Description	Current Application OH	UH/AH	CH	Major Elements of Replacement Task	Design Considerations Index
Rotor System					
Droop Stop			X	Remove/Install Component	E 27,14
				Fault Isolate	A 1,20
				Inspect Test	H 2
Main Rotor Damper Assembly	X		X	Remove/Install Component	E 1,9,13
				Fault Isolate	A 2,17,19
				Inspect/Test	H 1,3
Main Rotor Hub Assembly	X	X		Other Components	C 1,4,5,9,11,15
				Remove/Install Component	E 1,9,14,32
				Adjust	G 1
				Fault Isolate	A 2,3,17,19
Main Rotor Hub Assembly			X	Other Components	C 1,3,7,12,14
				Remove/Install Component	E 1,10,14,25,32
				Inspect/Test	H 1,3,4,9,10
				Service	F 1,6
Tail Rotor Blade	X	X		Remove/Install Component	E 9,17,25
				Other Components	C 6,14,15
				Adjust	G 1,2,7
Tail Rotor Blade			X	Remove/Install Component	E 9,17,27,32
				Fault Isolate	A 1,3,20
				Adjust	G 1,2

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS

Component Nomenclature and Description	Current Application OH	UH/AH	CH	Major Elements of Replacement Task	Design Considerations Index
Tail Rotor Hub	X	X		Other Components Remove/Install Component Adjust	C 14 E 9,10,13,14,25 G 1,2,9
Tail Rotor Hub			X	Other Components Remove/Install Component Inspect/Test	C 12,13,14 E 1,9,14,25,32 H 1,2,4,7

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS

Component Nomenclature and Description	Current Application OH	Current Application UH/AH	Current Application CH	Major Elements of Replacement Task	Design Considerations Index
Engine and Auxiliary Powerplant Systems					
Anti-Ice Actuator	X			Remove/Install Component	E 13,16,27
				Fault Isolate	A 3,14
				Access	B 3
				Buildup Items	D 27
Auxiliary Powerplant (Internal Mounting)			X	Remove/Install Component	E 5,31,32
				Buildup Items	D 19,20,27,28
				Other Components	C 39,41
Auxiliary Powerplant (External Mounting)			X	Remove/Install Component	E 5,26,31
				Buildup Items	D 19,20,27,28
				Other Components	C 27,33,34
APU Hydraulic Pump			X	Remove/Install Component	E 1,7
				Access	B 7
				Service	F 1,3
Droop Compensator	X	X		Remove/Install Component	E 16,27
				Inspect/Test	H 1
				Adjust	G 4,5
				Gain Access	B 3
				Fault Isolate	A 1,20
Engine Installation (Internal Fuselage Mounted)	X	X		Buildup Items	D 7,8,9,15,16,17
				Remove/Install Component	E 1,7,9,25,27,31
				Other Components	C 18,27,39,45,46

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS

Page 6

Component Nomenclature and Description	Current Application OH	Current Application UH/AH	Current Application CH	Major Elements of Replacement Task	Design Considerations Index
Engine Installation (Exterior Pod Mounted)			X	Buildup Items	D 7,8,9,12,14,17
				Remove/Install Component	E 1,5,7,25,32
				Other Components	C 18,24,27,39,45
Engine Oil Filter	X			Remove/Install Component	E 25,28
				Fault Isolate	A 1,2
				Service	F 4
Engine Oil Pump			X	Other Components	C 39
				Remove/Install Component	E 26,27
				Service	F 1,5
Fuel Pump	X			Remove/Install Component	E 9,10
				Fault Isolate	A 18,1[illegible]
				Buildup Items	D 2[illegible]
Governor	X			Remove/Install Component	E 9,10
				Fault Isolate	A 18,19
				Buildup Items	D 28
Linear Actuator		X		Remove/Install Component	E 5,10,16,25
				Adjust	G 4,5,8
Main Fuel Control	X	X		Remove/Install Component	E 5,7,10,16
				Fault Isolate	A 2,3,18,20
				Adjust	G 11,12,13

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS

Component Nomenclature and Description	Current Application OH	UH/ AH	CH	Major Elements of Replacement Task	Design Considerations Index
Main Fuel Control			X	Remove/Install Component	E 5,7,16,25
				Fault Isolate	A 2,3,18,20
				Inspect/Test	H 1,3,6,9
Oil Cooler	X	X		Remove/Install Component	E 5,13,27
				Other Components	C 38,39
				Fault Isolate	A 2,12,18
Oil Pump			X	Other Components	C 39
				Remove/Install Component	E 5,27
				Service	F 1,5

Component Nomenclature and Description	Current Application OH	UH/AH	CH	Major Elements of Replacement Task	Design Considerations Index
Drives System					
Engine Transmission Assembly (Pod mounted engine)			X	Remove/Install Component Other Components Access	E 1,2,5,14, C 19 B 1,2,8
Combining Transmission Assembly (Twin engine tandem rotor)			X	Remove/Install Component Other Components Buildup Items	E 1,2,5,12,14,24 C 19,20 D 5,28
Main Transmission Assembly (Hard mounted to fuselage structure beneath independently mounted rotor mast)	X			Other Components Access Inspect/Test	C 17,18,22,35 B 1,4,6 H 1
Main Transmission Assembly (Semi-soft mounted to fuselage structure - has integral rotor mast)	X			Other Components Remove/Install Component Access	C 1,2,9,18,40,41 E 5,14 B 1,2
Main Transmission Assembly (Soft mounted in pylon structure, has integral rotor mast)		X		Remove/Install Component Other Components Buildup Items	E 1,2,5,14 C 1,2,9,18,22,41 D 4,18,22,25,26

Component Nomenclature and Description	Current Application OH	UH/AH	CH	Major Elements of Replacement Task	Design Considerations Index
Main Transmission Assembly (Hard mounted to fuselage structure, has integral rotor mast)			X	Other Components Remove/Install Component Buildup Items	C 1,7,18,22,23,24 E 1,2,5,6,30 D 1,2,3,21,23,26
Main Rotor Mast Assembly (Mounted to, and integral with, the transmission assembly)		X		Remove/Install Component Other Components Inspect/Test	E 1,5,6,30 C 1,2,4,5,9,12 H 1,11
Rotor Mast Assembly (Tandem rotor-mounted independent of transmission assembly)			X	Other Components Remove/Install Component Inspect/Test	C 1,2,9 E 1,5,6,15 H 1,12,15
Forward Transmission Assembly (Tandem rotor helicopter)			X	Remove/Install Component Other Components Inspect/Test	E 1,2,5,6,20,24 C 1,8,20,21 H 1,12,13
Aft Transmission Assembly (Tandem rotor helicopter)			X	Remove/Install Component Inspect/Test Other Components	E 1,2,5,6,14 H 1,12 C 7,20,36,41,42
Intermediate Gear ox Assembly		X		Remove/Install Component Other Components Access	E 2 C 22 B [illegible]

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS

Component Nomenclature and Description	Current Application OH	Current Application UH/AH	Current Application CH	Major Elements of Replacement Task	Design Considerations Index
Intermediate Gearbox Assembly			X	Remove/Install Component Fault Isolate Inspect/Test	E 2·22 A 2,4,5 H 1
Tail Rotor Gearbox Assembly (Removed/installed with tail rotor drive shaft as a unit)	X			Other Components Adjust Remove/Install Component	C 6,12,22 G 14 E 2,11,14
Tail Rotor Gearbox Assembly (Disconnected from tail rotor drive shaft prior to removal)	X	X	X	Other Components Remove/Install Component Fault Isolate	C 6,12,22 E 2,19,29 A 2,4,5,6
Engine-to-Transmission Drive Shaft (Flexible diaphragm type)	X			Access Remove/Install Component Adjust	B 1,6 E 7 G 14
Engine-to-Transmission Drive Shaft (Flexible spline type)	X	X		Service Inspect/Test Remove/Install Component	F 7 H 14 E 23
Tail Rotor Drive Shaft (One-piece long shaft, supported at transmission and at tail rotor diaphragm couplings)	X			Adjust Remove/Install Component Other Components	G 14 E 18 C 6,12,17

MAINTAINABILITY CHECKLIST - PART I - TASK ELEMENTS

Component Nomenclature and Description	Current Application OH	Current Application UH/AH	Current Application CH	Major Elements of Replacement Task	Design Considerations Index
Tail Rotor Drive Shaft (Short length, supported at one end by hanger bearing and at other end by flexible spline coupling)		X		Remove/Install Component Access Fault Isolate	E 23 B 3 A 9,10,21
Tail Rotor Drive Shaft (Short length, supported at one end by hanger bearing with fiscous damper and at other end by a flexible steel disc coupling)			X	Remove/Install Component Buildup Items Fault Isolate	E 22 D 6 A 10
Rotor Drive/Snychronizing Shaft (Short length, supported at one end by a shock mounted hanger bearing and at the other end by a flexible steel disc coupling)			X	Remove/Install Component Adjust Fault Isolate	E 12 G 15 A 10
Tail Rotor Shaft Hanger Assembly (Includes support bearing, flexible spline coupling, and rigid coupling)		X		Other Components Remove/Install Component Fault Isolate	C 22 A 7,11

Component Nomenclature and Description	Current Application OH	UH/AH	CH	Major Elements of Replacement Task	Design Considerations Index
AFCS Servo Unit and Electrical Generators					
AFCS Servo Unit			X	Remove/Install Component	E 2,8,16,28
				Fault Isolate	A 1,19
				Inspect/Test	H 1,3,4
Starter/Generator	X	X		Remove/Install Component	E 2,3,7,17,25
				Gain Access	B 3
				Fault Isolate	A 14,18,20
Generator			X	Remove/Install Component	E 2,7,8,30,32
				Fault Isolate	A 13,14,19,20
				Other Components	C 43,45
				Inspect/Test	H 1,10

MAINTAINABILITY CHECKLIST

PART II - DESIGN CONSIDERATIONS

A. FAULT ISOLATE
(Methods utilized and/or related problems)

1. Cause of malfunction detected by visual inspection.

2. Leaks are detected visually.

3. Visually inspect for general condition, security (looseness) of component and connections.

4. Internal failures are detected by magnetic chip detectors.

5. Incipient internal failures are detected by Spectographic Oil Analysis Program (SOAP) oil samples.

6. Gear patterns are visually checked through filler port or sight gage port.

7. Disassembly, cleaning and visual inspection of individual spline teeth required.

8. Check for binding and dragging of bearings by tension devices, gages, and feel.

9. Out-of-balance condition usually noted via vibration in rudder pedals.

10. Acceptable depth of scratches and nicks is limited and must be measured with micrometers, dial indicators, etc.

11. Temperature crayon used to check operating temperatures.

12. Performing a temperature measurement check by cockpit gage, temperature measurement device and/or feel.

13. Verifying electrical current indicators.

14. Troubleshooting requires referencing electrical schematic diagrams.

15. Pressurizing and de-pressurizing flight control hydraulic system.

16. Verifying hydraulic pressure indicators.

17. Operating controls through full range of travel to determine obstructed travel.

18. Requires engine start and functional check run.

19. Fault or malfunction is not clearly visible and requires system testing to determine equipment status and cause of failure.

20. Degree of logical analysis required to determine origin of fault or malfunction.

21. Balance weights (straps) are pulled from shaft during manufacture. Mechanics see patch of old adhesive and believe weight lost during operation.

B. <u>ACCESS</u>
(Current provisions and/or related problems)

1. Cowling secured by screws is removed and reinstalled.
2. Fairing secured by screws is removed and reinstalled.
3. Hinged doors secured by dzues fasteners.
4. Panel secured by screws is removed and reinstalled.
5. Fire wall secured by screws is removed and reinstalled.
6. Sound insulation is removed and reinstalled.
7. Internal access covers and drip pan removed and reinstalled.
8. Barrel nuts and bolts used to secure cowling. Barrel nuts difficult to align and crossed threading sometimes occurs.

C. <u>OTHER COMPONENTS</u>
(Components which must be removed to provide access to the subject component)

1. Main Rotor Blades

2. Main Rotor Hub.

3. Weather Protective Cover.

4. Stabilizer Bar Assembly.

5. Stabilizer Dampers and Supports.

6. Tail Rotor Assembly.

7. Flight Control Hydraulic Actuator.

8. Speed Trim Actuator or Yoke Assembly.

9. Swashplate and Support Assembly.

10. Collar Set.

11. Scissors Assembly.

12. Flight Control Linkage.

13. Pitch Change Beam.

14. Pitch Change Links/Rods.

15. Main Rotor Drive Shaft Assembly (Mast).

16. Fifth Mount Beam.

17. Tail Rotor Gearbox.

18. Engine-to-Transmission Drive Shaft.

19. Engine Transmission-to-Combining Transmission Drive Shaft.

20. Rotor Drive/Synchronizing Shaft.

21. Shaft Adapter and Plate Assembly.

22. Tail Rotor Drive Shaft.

23. Engine Assembly (disconnected and moved forward).

24. Air Particle Separator.

25. Engine Air Inlet Screen.

26. Fuel Control Assembly.

27. Control Links/Rods.

28. Fuel Boost Pump, Fuel Purifier.

29. Start/Main Fuel Solenoid Valve.

30. Fuel Inlet Filter.

31. Fuel Pressure Switch

32. Tail Pipe Assembly.

33. APP Clutch Assembly.

34. APP Drive Shaft.

35. Oil Cooler Blower.

36. Blower Drive Shaft.

37. Oil Cooler.

38. Oil Cooler Ducting.

39. Lines and Hoses.

40. Hydraulic Reservoir.

41. Hydraulic Pump.

42. Electric Generator.

43. Generator Shroud and Flexible Duct.

44. Rotor Tach Generator.

45. Electrical Leads (disconnected)

46. Armor Plating.

D. BUILDUP ITEMS
(List of accessories, fittings, brackets, etc. which must be transferred from removed component to replacement component)

1. Main Rotor Head.

2. Flight Control Actuators.

3. Rotor Brake.

4. Lift Link Spacer.

5. Shaft Adapter and Plate Assembly.

6. Tail Rotor Drive Shaft Support Bearing.

7. Power Turbine Governor.

8. Engine Mounting Pads/Trunnions.

9. Linear Actuator.

10. Bleed Air Control Valve.

11. Ignition Exciter.

12. Anti-Ice Valve.

13. Oil Filter Assembly.

14. Fuel Pump.

15. Starter-Generator.

16. Droop Compensator Cambox.

17. Gas Producer Fuel Control.

18. Tach Generator.

19. APP Starter.

20. APP Tailpipe

21. Hydraulic Pump.

22. Cockpit Air Blower (AH-1 only).

23. Oil Cooler and support Assembly.

24. Lines and Hoses.

25. Electric Harness Assembly.

26. Electric Generator.

27. Mounting Brackets and Supports.

28. Elbows, Reducers, Unions, Gaskets, "O" Rings, etc.

E. REMOVE/INSTALL COMPONENT
(Significant or nonobvious steps of replacement task and/or related problems)

1. Special tools/equipment required.

2. Electrical wiring is disconnected/reconnected.

3. Wiring diagrams must be referenced when making connections.

4. Bonding jumper is disconnected/reconnected.

5. Pressure, vent and/or drain lines are disconnected/reconnected. Lines and ports are capped/plugged to prevent possible contamination.

6. Temporary covers or barrier papers are required.

7. Attaching bolts, nuts, etc., are in close proximity to structure or other components. Use of wrench is difficult.

8. Subject component is located in congested area.

9. Various sized hardware are utilized.

10. Various torque values are specified.

11. Primer is applied to mounting bolts prior to reinstallation.

12. Stack-up under mount bolts is adjusted by washers so that one exposed thread on bolt results.

13. Spacers and/or shims are utilized to provide specified clearances/tolerances.

14. Lockwire and/or cotter pins are required.

15. Safety blocks must be installed on each outboard piston of pivoting and swiveling dual actuating cylinders.

16. Control rods, tubes, and other linkages are disconnected/reconnected.

17. Control and/or rotor components are indexed by color coding for proper reinstallation.

18. Tail rotor, tail rotor gearbox, and tail rotor drive shaft are removed from tail boom as a unit and then separated.

19. Pitch change mechanism and tail rotor gearbox are removed from tail boom as a unit.

20. Keys which connect transmission input shaft with adapter and plate assembly must be custom indexed and drilled.

21. Two tail rotor drive shafts must be disconnected from gearbox couplings.

22. Adjacent tail rotor drive shaft is disconnected and temporarily supported.

23. Gaps between matched halves of coupling clamps must be equal within .030 inch.

24. Component cannot be lifted straight up, but must be turned and/or tilted to clear items not being removed.

25. Special procedures and/or caution required for component replacement.

26. Numerous fittings, brackets, support studs, and associated hardware are removed/reinstalled during component replacement process.

27. Many small detail parts which are subject to loss or misplacement are included in the replacement assembly.

28. Residual pressure must be dissipated.

29. Dissimilar metal tape is used between faying surfaces upon reinstallation of component.

30. Sealing compound must be prepared and applied.

31. Large degree of arm, leg and back strength required by mechanic for lifting component.

32. Replacement of component requires sustained physical effort holding and carrying heavy assemblies, tools and parts.

F. SERVICE
(Current requirements and/or related problems)

1. Draining/filling component and/or system with hydraulic fluid or oil.

2. Requires bleeding system.

3. Servicing and/or draining corrosion preventive fluid from component.

4. Complete oil drainage (puddled oil) requires suction gun or other device.

5. Priming the component with appropriate fluid.

6. Purging fittings with grease.

7. Hand packing flexible spline couplings with grease. Volume of grease is very critical.

G. ADJUST
(Applicable types and/or related problems)

1. Tracking rotor system.

2. Normally requires flight control system rigging.

3. Rigging cyclic control system.

4. Minor adjustments to control linkages.

5. Normally requires rigging power controls.

6. Applying preload to spring.

7. Perform balance of component.

8. Adjusting stroke length with adjustment screw.

9. Retorquing hardware after specific hour utilization.

10. Bearing friction check and adjustment.

11. Adjusting feedback rod ends.

12. Prime and adjust component.

13. Power check and trim adjustments.

14. Compression of flexible diaphragm coupling is checked with feeler gage and shimmed as necessary. Total thickness of shims is divided between two couplings.

15. Rotors must be brought into proper phase via mechanism in combining transmission after components in drive system are disconnected.

H. INSPECT/TEST
(Methods utilized and/or related problems)

1. Maintenance Operational Check (MOC) is performed.

2. Mechanical components are functionally checked for proper operation.

3. Check for leaks.

4. Flight control rigging is checked.

5. Neutral rig position check is performed.

6. Controls clearance is checked.

7. Bearing axial play is checked.

8. Bearing retainer-to-bushing flange clearance is determined.

9. Critical torque values must be verified (witnessed) by Technical Inspector.

10. Looseness check.

11. Measurement of dimension between transmission case and planetary adapter is made.

12. Torque on mount bolts is checked after 25 flight hours.

13. Torque on rotor retention nut is checked after 25 flight hours.

14. Disassembly of coupling is required. Each spline tooth is individually cleaned and visually inspected.

15. Aft thrust bearing lube line is temporarily disconnected and with APU operating, oil flow through line is checked.

CONCLUSIONS

The objective of this study has been to identify the factors responsible for the high expenditures of maintenance effort on selected components of current-inventory Army helicopters. Examination of historical maintenance data, engineering analysis and field surveys have been used to establish: (1) the components of each helicopter which are the greatest man-hour consumers within the classes of generic components investigated, (2) the causes for the maintenance demand on these items in terms of failure modes, maintenance frequency and average repair time, (3) the structure of major component replacement tasks in terms of discrete time elements and (4) the important factors bearing upon maintenance task performance. The thrust of the study has been on data-gathering, analysis and problem identification.

The ten major component areas set forth by the government for study each encompassed several or more types of components. Initial decisions concerning the selection of specific components to be investigated within the ten generic component classes on each helicopter were based on historical maintenance data derived from the Army TAMMS and from the Navy and Marine Corps 3-M system. The depth and quality of the data base was considered among the best available from the current military reporting systems. Much has been done by the military over recent years to improve the accuracy and completeness of field data. Despite these efforts, however, major deficiencies continue to exist. Considerable care was given to the processing and analysis of data for this program to insure that the information was being properly interpreted. This included both the manual and computer operations.

In some instances, however, the data being used to analyze the maintenance history on specific components contained obvious or suspected errors and omissions. Occasionally, it was possible to read around errors and fill blanks by judgement. More often, the data had to be accepted without qualification. Since the selection of components for detailed analysis rested heavily on the maintenance experience developed from the field data, error-free data may have altered the mix of components analyzed somewhat.

A major part of this study has been devoted to analyzing maintenance tasks and establishing the fraction of total effort expended on specifically defined functions or elements. As brought out in earlier discussions, maintenance time is substantially influenced by a variety of factors which are

seldom found exactly alike in any two maintenance operations. The maintenance time statistics resulting from this work are based on a thorough technical analysis are considered valid averages or norms for the tasks involved. It is quite possible to find significantly different numbers for these same tasks, however, depending upon the source of the data, the conditions under which it was obtained, etc. The value of the maintenance task time information contained in this report lies, therefore, not so much in its use as a time-study type of standard but more in its use for comparative analyses within and among different aircraft and components. Since the data was compiled using common ground rules and analysis techniques, it is especially suited to this latter purpose.

It is somewhat difficult to draw general conclusions from this study. Six different helicopters have been analyzed, among which there are found major differences in size, complexity and design. Accessibility and component packaging are factors which were found generally applicable to the maintenance time requirements across all models for those systems investigated. This conclusion is largely intuitive, however, considering the hardware complexity of helicopters. Rotor blades must be removed to get to the hub, the hub must be removed to get to the swashplate, swashplate to get to the gearbox, etc. The labor involved is additive - a gearbox change is necessarily time-consuming.

Plumbing and mechanical controls are areas of general similarity in all helicopters. The helicopter has, typically, a great number of fuel, oil and hydraulic lines routed through various compartments of the aircraft, often surrounding and obstructing access to other components. Such lines are frequently subject to removal in the course of maintenance operations and contribute to the maintenance consumption rate. Mechanical linkages such as those found in the flight control systems also present similar problems. They are frequently located in inaccessible locations of the aircraft and are often disconnected as a result of replacing rotor and drive system components. Subsequent rigging and adjustments also add to the time for maintenance.

Part stackups, often involving numerous details with intricate alignment or shimming requirements, are another common factor in the maintenance time problem.

These are some of the general observations in the study results. As already noted, however, the individual aircraft covered by the study are unalike in major respects and present rather unique maintenance problems in most areas. A detailed examination of the tabulated data will show the areas of greatest maintenance consumption for individual aircraft

and the specific factors involved.

One of the uses to which the results of the study may logically have application is a study of the helicopter design characteristics which influence the maintenance function. The maintenance task time data and supporting information developed here can be used to pinpoint areas of high man-hour consumption where new approaches to design might offer improvement. Care is needed in the interpretation of maintenance time as an indicator of problem frequency or magnitude, however. A heavy man-hour requirement is not necessarily indicative of a problem at all. Helicopter drive components, by virtue of their physical characteristics and function in the system, are traditionally greater consumers of maintenance time than less complex items of the aircraft. To concentrate attention on these components may perhaps cause more fertile areas for improvement to be neglected.

RECOMMENDATIONS

This study has identified the components of current-inventory helicopters which contribute most to the high man-hour cost of operation and quantified the problem in terms of maintenance time. No attempt has been made to develop solutions since this was beyond the scope of the task.

The logical extension of this work would be a study directed toward a better understanding of the design characteristics which complicate helicopter maintenance and the development of improved concepts for future aircraft. Solutions to helicopter maintenance problems evolve rather easily, of course, if all other considerations of aircraft design - performance, weight, cost, etc. - are placed in lower priority to maintainability. This obviously will not occur. The search for solutions to the maintenance problem must consider the ramifications of design alternatives in these other important areas.

If a design concept study evolves as the continuation of this work, it is recommended that:

(1) The scope of the task in terms of the number of problems to be attacked not be so broad as to prohibit an adequate analysis of any one problem. Carefully considered and properly analyzed solutions should be sought.

(2) Some type of cost-effectiveness analysis be required in any such work to provide the Government with a standard for comparing the relative merits of the various design recommendations.

APPENDIX I

COMPONENT REPLACEMENT TASKS RANKED BY AVERAGE MAN-HOURS

Tables XVII through XXII list the selected components of each of the six helicopter models in descending order by average man-hours for replacement. The task frequency is shown in terms of mean-time-between-maintenance (MTBM). Man-hours per 100,000 flight-hours is also given.

TABLE XVII. COMPONENT REPLACEMENT TASKS RANKED BY AVERAGE MAN-HOURS, OH-58 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBR	Avg Man-Hr	MH/FH x 10^3
22500	T63 Engine	On	D.S.	474	28.9	6,112
26210	Main Trans.	On	D.S.	1,613	13.9	867
15111	Main Rotor Hub	On	D.S.	4,762	7.4	154
14128	Swashplate/Suppt. Assembly	On	D.S.	2,857	6.2	215
15211	Tail Rotor Hub	On	Org	2,631	5.4	206
26416	Tail Rotor Gear Box	On	Org	3,226	4.7	147
15215	Tail Rotor Blade	On	D.S.	1,149	4.4	381
26111	Engine to Trans.Drive Shaft	On	Org	1,695	3.9	230
29411	Oil Cooler	On	Org	1,695	3.8	224
22562	Main Fuel Control	On	D.S.	1,205	3.4	283
22563	Governor	On	D.S.	1,316	3.0	229
22561	Fuel Pump	On	D.S.	926	2.8	301
26413	Hanger Bearing	On	Org	2,222	2.8	126
14144	Collective Servo Actuator	On	Org	5,882	2.7	47
14142	Cyclic Servo Actuator	On	Org	800	2.5	312
22566	Fuel Check Valve	On	D.S.	1,613	2.2	137
29711	Anti-Ice Control Actuator	On	Org	4,762	2.2	46
29310	Droop Compensator	On	Org	2,857	2.1	73
42111	Starter Generator	On	Org	270	2.0	742
22593	Ignition Lead	On	Org	5,882	1.7	29
22572	Lube Filter	On	Org	4,762	1.2	25
15114	Hub Grip Reservoir	On	Org	1,695	0.7	41
26411	Tail Rotor Drive Coupling	On	Org	10,000	0.6	43

TABLE XVIII. COMPONENT REPLACEMENT TASKS RANKED BY AVERAGE MAN-HOURS, OH-6 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10⁵
26012	Main Transmission	On	D.S.	364	15.6	4,286
22007	Engine	On	D.S.	169	14.5	8,580
15010	Main Rotor Hub Assembly	On	D.S.	662	8.3	1,252
14032	Main Rotor Swashplate	On	D.S.	1,111	7.2	648
26017	Tail Rotor Gearbox	On	D.S.	288	6.7	2,324
22062	Oil Cooler	On	D.S.	1,613	5.1	318
15153	Tail Rotor Blade	On	D.S.	4,762	3.8	80
26023	Tail Rotor Drive Shaft	On	D.S.	498	3.7	744
26126	Bearing Seal-T/R Gearbox	On	D.S.	2,041	3.7	181
22654	Gas Producer Fuel Control	On	D.S.	633	3.6	569
22044	Power Turbine Governor	On	D.S.	1,031	3.5	339
15003	Tail Rotor Hub Assembly	On	D.S.	429	3.2	747
26019	Main Drive Shaft	On	D.S.	437	2.4	550
15047	Main Rotor Damper Assembly	On	ORG	316	1.2	379
42055	Starter Generator	On	ORG	699	1.2	171
26187	Oil Filter-Main Transmission	On	ORG	1,667	1.0	60
22110	Engine Oil Filter	On	ORG	800	0.7	88

TABLE XIX. COMPONENT REPLACEMENT TASKS RANKED BY AVERAGE MAN-HOURS, UH-1 HELICOPTER						
Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22200	T-53 Engine	On	D.S.	281	42.2	15,015
26211	Main Transmission	On	D.S.	1,163	31.4	2,691
15115	Main Rotor Hub Assembly	On	Org	298	11.1	3,734
2621C	Mast Assy.	On	D.S.	935	10.3	1,099
1412B	Swashplate/Support Assembly	On	Org	794	10.0	1,261
22261	Fuel Regulator	On	Org	1,887	7.8	416
2621E	Main Input Quill-Main Transmission	On	D.S.	909	7.3	803
1511D	Scissors/Sleeve Assembly	On	D.S.	329	5.7	2,489
22262	Main Fuel Manifold	On	Org	4,167	5.5	134
26415	Tail Rotor Gearbox	On	Org	410	4.9	1,197
2226310	Starting Fuel Nozzle	On	Org	6,667	4.4	64
14141	Flight Control Cylinder/Valve	On	Org	135	3.8	2,808
15212	Tail Rotor Blade Assembly	On	D.S.	164	3.7	2,262
15211	Tail Rotor Hub Assembly	On	D.S.	130	3.5	2,700
26112	Main Drive Shaft	On	Org	351	3.5	996
42211	Starter Generator	On	Org	1,235	3.2	259
29261	Tailpipe	On	D.S.	9,091	3.1	34
26414	Intermediate Gearbox	On	Org	617	3.1	501
29422	Oil Cooler	On	Org	3,125	3.1	100
42111	Generator	On	Org	862	2.7	314
22263	Starting Fuel Manifold	On	Org	16,667	2.5	16
29321	RPM Warning Detector Box	On	Org	171	2.4	1,405
29313	Droop Compensator Cam Box	On	D.S.	3,226	2.4	74
2931310	Linear Actuator	On	Org	680	2.1	309

TABLE XIX - Continued						
Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
14118	Collective Level Assembly	On	Org	1,282	2.1	163
29421	Oil Tank	On	Org	6,250	2.1	34
26413	Tail Rotor Shaft Hanger	On	Org	340	2.0	589
22291	Exciter Unit	On	Org	4,762	1.8	40
22293	Igniter Plug	On	Org	5,556	1.8	32
2923E	Particle Separator	On	Org	12,500	1.8	15
26411	Tail Rotor Drive Shaft	On	Org	1,064	1.7	159
2621K	Hose-Main Transmission	On	Org	6,667	1.7	25
15118	Main Rotor Counterweight	On	Org	9,091	1.4	16
2621J	Tubing-Main Transmission	On	Org	9,091	1.3	15
29132	Pillow Block Assembly	On	D.S.	12,500	1.3	10

TABLE XX. COMPONENT REPLACEMENT TASKS RANKED BY AVERAGE MAN-HOURS, AH-1 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22000	T-53 Engine	On	D.S.	292	43.0	14,723
26211	Main Transmission Assembly	On	D.S.	1,087	27.2	2,500
2621C	Mast Assembly	On	D.S.	775	8.3	1,074
1412B	Cyclic Swashplate/Support Assembly	On	Org.	585	7.5	1,284
15115	Main Rotor Hub Assembly	On	Org.	347	6.9	1,988
2621E	Main Input Quill Assembly	On	D.S.	746	6.4	855
22261	Fuel Regulator	On	Org.	3,030	6.0	200
26415	Tail Rotor Gearbox Assembly	On	Org.	369	4.8	1,303
29422	Oil Cooler	On	Org.	3,448	4.2	123
15212	Tail Rotor Blade Assembly	On	D.S.	478	3.7	773
15211	Tail Rotor Hub Assembly	On	D.S.	247	3.6	1,458
26111	Main Drive Shaft	On	Org.	413	3.4	823
42211	Starter/Generator	On	D.S.	1,587	3.3	207
14141	Flight Control Cylinder/Valve	On	Org.	244	3.2	1,309
26414	Intermediate Gearbox	On	Org.	427	2.6	608
29321	RPM Warning Detector Box	On	Org.	201	2.4	1,193
2931J10	Linear Actuator	On	Org.	452	2.3	509
2931J	Droop Compensator	On	Org.	3,030	2.3	77
29133	Tripod Assembly	On	D.S.	1,408	2.0	142
575C1	SCAS Control Assembly	On	D.S.	4,000	2.0	50
26413	Hanger Assembly	On	Org.	88	1.9	2,150
26411	Tail Rotor Drive	On	Org.	427	1.6	374
14118	Collective Lever Assembly	On	Org.	4,000	1.6	40
2621K	Hose-Main Transmission	On	Org.	5,882	1.4	23

TABLE XX - Continued						
Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22277	Oil Hose	On	Org.	2,381	1.3	54
29132	Pillow Block Assy.	On	D.S.	4,000	1.3	33
2621J	Tubing-Main Trans.	On	Org.	25,000	1.1	5

TABLE XXI. COMPONENT REPLACEMENT TASKS RANKED BY AVERAGE MAN-HOURS, CH-47 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22004	Turbine Engine	On	D.S.	78	77.6	10,000
26013	Aft Transmission Assembly	On	D.S.	274	42.6	15,562
26016	Forward Transmission Assy.	On	D.S.	407	39.0	9,594
26038	Aft Rotor Drive	On	D.S.	893	19.7	2,202
26086	Output Seal-Aft Transmission	On	Org.	465	15.0	3,220
14021	Swashplate Control	On	D.S.	357	14.1	3,952
15008	Rotary Wing Head	On	D.S.	110	10.8	9,839
26010	Combining Transmission	On	D.S.	183	7.6	4,160
24009	Aux. Power Unit	On	Org.	192	5.4	2,818
22101	Engine Oil Pump	On	Org.	1,639	5.4	330
26017	Engine Transmission Assy.	On	Org.	211	4.5	2,134
45011	Hydraulic Servo Cylinder	On	Org.	225	3.7	1,644
24169	APU Hydraulic Pump Motor	On	Org.	3,704	3.1	90
22157	Engine Starter	On	Org.	465	2.6	558
26012	Synchronizing Shaft Assy.	On	Org.	131	2.4	1,837
15102	Shock Absorber	On	Org.	332	2.3	693
22128	Power Turbine	On	Org.	575	2.3	400
26084	Adapter Assy., Rotor Drive	On	D.S.	1,639	2.2	134
26019	Trans., Shaft Assembly	On	D.S.	407	2.1	517
15133	Rotary Head Boot Assembly	On	Org.	228	1.9	833
14060	Drive Arm Assembly	On	D.S.	324	1.8	555
42054	A/C Generator	On	Org.	441	1.8	408
24376	APU Fuel Boost	On	Org.	4,167	1.8	43
22357	Engine Tailpipe Assembly	On	Org.	10,000	1.8	19

TABLE XXI - Continued

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22074	Fire Detection Sensing Element	On	Org.	121	1.7	1,407
15234	Spring Droop Stop	On	Org.	840	1.7	203
22310	Engine Exhaust Cone	On	Org.	1,923	1.7	89
15271	Droop Stop-Static	On	Org.	8,333	1.6	19

TABLE XXII. COMPONENT REPLACEMENT TASKS RANKED BY AVERAGE MAN-HOURS, CH-54 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
26011	Main Transmission	On	D.S.	444	97.7	21,992
22005	Engine	On	D.S.	85	52.8	62 135
15007	Main Rotor Head	On	D.S.	260	28.7	11,055
26019	Tail Rotor Gearbox	On	D.S.	407	20.8	5,119
15021	Tail Rotor Head	On	Org	323	9.8	3,041
26040	Main Input Seal- Main Transmission	On	D.S.	360	9.2	2,559
26083	Rotor Brake Seal- Main Transmission	On	D.S.	467	7.1	1,519
26042	Intermediate Gearbox	On	D.S.	549	7.1	1,296
57027	AFCS Servo Unit	On	Org	1,333	7.1	533
22037	Fuel Control	On	D.S.	444	6.4	1,434
24014	APP Engine	On	D.S.	4,762	6.4	137
22043	Partille Separator	On	Org	1,333	5.5	412
26066	Oil Pump-Main Transmission	On	D.S.	719	5.0	695
26029	Tail Rotor Drive Shaft Bearing	On	D.S.	126	4.7	3,721
24187	APP Fuel Pump	On	Org	3,125	4.4	141
26112	Brake Disc-Main Transmission	On	D.S.	621	3.9	628
22100	Eaps Blower	On	Org	667	3.4	510
24090	APP Fuel Control	On	Org	518	3.4	655
45010	Main Rotor Servo	On	D.S.	246	3.2	1,301
15016	Rotor Damper Assembly	On	Org	311	3.2	1,031
24159	APP Starter	On	Org	781	3.1	396
15006	Tail Rotor Blade	On	Org	114	2.9	2,544
26324	Tail Rotor Shaft Assembly	On	D.S.	1,031	2.6	252

TABLE XXII - Continued

Component Code and Nomenclature	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22150 Starter	On	Org	1,333	2.6	195
26329 Tail Rotor Shaft Assembly	On	D.S.	1,687	2.5	134
24038 APP Clutch	On	D.S.	621	2.3	370
42134 Generator	On	Org	292	2.0	685
22389 Anti-Ice Sensor	On	Org	4,762	1.9	41
22028 Tailpipe Assembly	On	D.S.	88	1.8	2,042
26260 Chip Detector	On	Org	3,125	1.6	51
15079 Droop Restrainer	On	Org	228	1.5	658
15208 Bearing-Pitch Change Link	On	Org	360	1.4	390
22113 Anti-Ice Valve	On	Org	667	1.3	195
57420 AFCS Amplifier	On	Org	4,762	1.2	24

APPENDIX II

COMPONENT ON-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS

Tables XXIII through XXVIII list the selected components of each of the six helicopter models in descending order by the average man-hours required for on-aircraft repair. The task frequency is shown in terms of mean-time-between-maintenance (MTBM). Man-hours per 100,000 flight-hours is also given.

TABLE XXIII. COMPONENT ON-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, OH-58 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
15111	Main Rotor Hub	On	D.S.	336	7.6	2,258
26111	Engine to Transmission Drive Shaft	On	Org	370	4.0	1,088
26210	Main Transmission	On	Org	1,111	3.8	347
1412B	Swashplate/Suppt. Assembly	On	D.S.	613	3.4	546
26416	Tail Rotor Gearbox	On	Org	331	3.1	943
22572	Lube Filter	On	Org	1,149	2.5	218
14142	Cyclic Servo Actuator	On	Org	459	2.3	493
22561	Fuel Pump	On	Org	1,031	2.3	219
26413	Hanger Bearing	On	Org	474	2.0	433
22563	Governor	On	Org	926	2.0	213
15215	Tail Rotor Blade	On	Org	990	1.8	185
42111	Starter Generator	On	Org	185	1.7	909
22562	Main Fuel Control	On	Org	412	1.7	410
15211	Tail Rotor Hub	On	D.S.	719	1.6	226
15114	Hub Grip Reservoir	On	Org	81	1.5	1,819
14144	Collective Servo Actuator	On	Org	1,818	1.3	71
29711	Anti-Ice Control Actuator	On	Org	7,143	1.1	16
22593	Ignition Lead	On	Org	10,000	1.1	11
22566	Fuel Check Valve	On	Org	2,381	1.0	43
29411	Oil Cooler	On	Org	2,857	1.0	34
26411	Tail Rotor Drive Coupling	On	-	1,818	0.9	53

TABLE XXIV. COMPONENT ON-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, OH-6 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
15010	Main Rotor Hub Assembly	On	D.S.	185	9.0	4,335
22062	Oil Cooler	On	D.S.	25,000	6.4	26
22007	Engine	On	D.S.	885	5.9	669
15003	Tail Rotor Hub Assembly	On	D.S.	9,091	4.3	48

TABLE XXV. COMPONENT ON-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, UH-1 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
15115	Main Rotor Hub Assembly	On	D.S.	694	17.8	2,561
2621E	Main Input Quill-Main Transmission	On	D.S.	1,235	5.0	406
2226310	Starting Fuel Nozzle	On	Org	20,000	4.8	23
22293	Igniter Plug	On	Org	4,348	3.7	83
1412B	Swashplate/Support Assembly	On	Org	469	3.4	734
26111	Main Drive Shaft	On	Org	1,818	3.2	178
22262	Main Fuel Manifold	On	Org	2,381	3.0	124
26413	Tail Rotor Shaft Hanger	On	Org	1,316	2.6	201
14141	Flight Control Cylinder/Valve	On	Org	118	2.5	2,087
22200	T-53 Engine	On	D.S.	315	2.3	715
42111	Generator	On	Org	1,205	2.1	173
1511D	Scissors/Sleeve Assembly	On	D.S.	415	2.0	474
42211	Starter Generator	On	Org	1,315	2.0	[illegible]
15118	Main Rotor Counterweight	On	Org	2,778	2.0	72
15211	Tail Rotor Hub Assembly	On	D.S.	532	1.9	360
14118	Collective Lever Assembly	On	Org	637	1.9	303
2923E	Particle Separator	On	Org	2,128	1.8	84
22291	Exciter Unit	On	Org	4,762	1.7	35
26415	Tail Rotor Gearbox	On	Org	293	1.6	547
29422	Oil Cooler	On	Org	2,381	1.6	68
29321	RPM Warning Detector Box	On	Org	310	1.5	474
22261	Fuel Regulator	On	Org	490	1.5	315
26411	Tail Rotor Drive Shaft	On	Org	1,587	1.5	98
2621C	Mast Assembly	On	D.S.	1,449	1.4	98
2931J	Droop Compensator Cam Box	On	Org	529	1.3	242

TABLE XXV – Continued

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
29132	Pillow Block Assembly	On	D.S.	4,762	1.3	27
22263	Starting Fuel Manifold	On	Org	2,941	1.2	40
2621K	Hose-Main Transmission	On	Org	4,167	1.2	28
2931J10	Linear Actuator	On	Org	382	1.1	280
29421	Oil Tank	On	Org	2,083	1.1	52
26414	Intermediate Gearbox	On	Org	735	1.0	135
2621J	Tubing-Main Transmission	On	Org	4,167	1.0	25
29621	Tailpipe	On	D.S.	12,500	1.0	8

TABLE XXVI. COMPONENT ON-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, AH-1 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	[illegible]	Avg Man-Hr	MH/FH x 10^5
1412B	Cyclic Swashplate/Support Assembly	On	Org.	826	4.8	576
2621E	Main Input Quill Assembly	On	D.S.	2,381	3.8	157
14141	Flight Control Cylinder/ Valve	On	Org.	303	3.5	1,144
22200	T-53 Engine	On	D.S.	725	3.0	408
29422	Oil Cooler	On	Org.	3,030	2.6	87
42211	Starter/Generator	On	D.S.	826	2.2	269
2621C	Mast Assembly	On	D.S.	1,136	1.8	157
15115	Main Rotor Hub Assembly	On	Org.	400	1.5	366
29133	Tripod Assembly	On	D.S.	1,493	1.5	103
14188	Collective Lever Assembly	On	Org.	3,448	1.4	42
2621J	Tubing-Main Transmission	On	Org.	7,692	1.3	17
29321	RPM Warning Detector Box	On	Org.	189	1.2	635
575C1	SCAS Control Assembly	On	D.S.	4,762	1.1	24
2931J10	Linear Actuator	On	Org.	303	1.0	[illegible]
26411	Tail Rotor Drive Shaft Assembly	On	Org.	885	1.0	114
22261	Fuel Regulator	On	Org.	630	0.9	
15212	Tail Rotor Blade Assembly	On	D.S.	2,174	0.9	42
29132	Pillow Block Assembly	On	D.S.	7,692	0.9	11
26415	Tail Rotor Gearbox	On	Org.	629	0.8	129
26414	Intermediate Gearbox	On	Org.	685	0.8	86
2931J	Droop Compensator Cam Box	On	Org.	452	0.7	155
2621K	Hose-Main Transmission	On	Org.	5,882	0.6	10
22277	Oil Hose	On	Org.	2,000	0.4	22

TABLE XXVII. COMPONENT ON-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, CH-47 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBR	Avg Man-Hr	MH/FH x 10^5
42054	A/C Generator	On	Org.	1,493	5.9	663
22357	Engine Tailpipe Assembly	On	Org.	100,000	3.0	4
26038	Aft Rotor Drive Shaft	On	D.S.	6,667	2.6	39
22374	Fire Detection Sensing Element	On	Org.	1,667	2.3	137
24009	Aux. Power Unit	On	Org.	1,351	2.0	150
22101	Engine Oil Pump	On	Org.	7,692	2.0	27
15133	Rotary Head Boot Assembly	On	Org.	2,564	1.5	59
26010	Combining Transmission	On	D.S.	699	1.2	169
26173	Chip Detector-Engine Transmission	On	Org.	3,226	1.1	34
15271	Droop Stop-Static	On	Org.	12,500	1.0	8
26016	Forward Transmission Assembly	On	D.S.	1,429	0.6	39
26013	Aft Transmission Assembly	On	D.S.	140	0.2	114

TABLE XXVIII. COMPONENT ON-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, CH-54 HELICOPTER

Component Code and Nomenclature	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
24014 APP Engine	On	D.S.	719	60.0	8,346
22005 Engine	On	D.S.	199	6.9	3,473
15006 Tail Rotor Blade	On	D.S.	83	3.3	3,996
15021 Tail Rotor Head	On	Org.	3,125	3.3	107
26042 Intermediate Gearbox	On	D.S.	847	2.8	330
24038 APP Clutch	On	D.S.	4,762	2.8	59
22028 Tailpipe Assembly	On	D.S.	781	2.4	311
26260 Chip Detector - Tail Rotor Gearbox	On	Org.	1,887	1.8	94
22369 Anti-Ice Sensor	On	Org.	9,091	0.5	5

APPENDIX III

COMPONENT OFF-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS

Tables XXIX through XXXIII list the selected components of five of the six helicopter models in descending order by average man-hours required for off-aircraft repair. The task frequency is shown in terms of mean-time-between-maintenance (MTBM). Man-hours per 100,000 flight-hours is also given.

TABLE XXIX. COMPONENT OFF-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, OH-6 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
15003	Tail Rotor Hub Assembly	Off	D.S.	93	10.0	10,773
22007	Engine	Off	D.S.	139	10.0	7,211
26012	Main Transmission	Off	D.S.	177	7.0	3,989
26017	Tail Rotor Gearbox	Off	D.S.	195	4.0	2,064
26023	Tail Rotor Drive Shaft	Off	D.S.	212	2.0	932
15153	Tail Rotor Blade	Off	-	33,333	1.7	5

TABLE XXX. COMPONENT OFF-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, UH-1 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22200	T-53 Engine	Off	D.S.	781	19.2	2,450
22262	Main Fuel Manifold	Off	D.S.	50,000	17.2	28
15211	Tail Rotor Hub Assembly	Off	D.S.	249	3.9	1,563
26111	Main Drive Shaft	Off	D.S.	870	3.7	425
29621	Tailpipe	Off	D.S.	33,333	2.8	9
26413	Tail Rotor Shaft Hangar	Off	G.S.	909	2.5	272
2931J10	Linear Actuator	Off	D.S.	1,538	2.0	127
29321	RPM Warning Detector Box	Off	D.S.	179	1.8	1,000

TABLE XXXI. COMPONENT OFF-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, AH-1 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22200	T-53 Engine	Off	D.S.	2,381	15.3	641
15115	Main Rotor Hub Assy.	Off	D.S.	685	11.7	1,715
26111	Main Drive Shaft	Off	D.S.	685	3.3	489
15211	Tail Rotor Hub Assy.	Off	D.S.	704	2.8	395
26413	Hanger Assy.	Off	D.S.	312	1.8	595
2931J10	Linear Actuator	Off	D.S.	1,205	1.2	101
29321	RPM Warning Detector Box	Off	D.S.	224	1.1	493

TABLE XXXII. COMPONENT OFF-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, CH-47 HELICOPTER

Component Code and Nomenclature		On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
24009	Aux. Power Unit	Off	D.S.	645	117.7	18,250
15008	Rotary-Wing Head Assembly	Off	D.S.	400	80.0	20,039
22004	Turbine Engine	Off	D.S.	200	79.9	39,930
26016	Forward Transmission Assy.	Off	D.S.	1,163	24.0	2,075
26010	Combining Transmission	Off	D.S.	637	23.9	3,757
24169	APU Hydraulic Pump-Motor	Off	D.S.	7,692	18.9	253
26019	Transmission, Shaft Assy.	Off	D.S.	1,754	13.9	787
26017	Engine Transmission Assy.	Off	D.S.	304	12.2	4,026
14021	Swashplate Control	Off	D.S.	1,961	12.0	608
45011	Hydraulic Servo Cylinder	Off	D.S.	141	12.0	8,481
26038	Aft Rotor Drive Shaft	Off	D.S.	3,030	10.4	340
14060	Drive Arm Assembly - Trans.	Off	D.S.	1,493	6.0	403

TABLE XXXIII. COMPONENT OFF-AIRCRAFT REPAIR TASKS RANKED BY AVERAGE MAN-HOURS, CH-54 HELICOPTER

Component Code and Nomenclature	On/Off Acft.	Level	MTBM	Avg Man-Hr	MH/FH x 10^5
22005 Engine	Off	D.S.	407	80.0	19,688
26019 Tail Rotor Gearbox	Off	D.S.	1,887	24.0	1,284
15006 Tail Rotor Blade	Off	D.S.	63	16.0	25,513
45010 Main Rotor Servo Unit	Off	D.S.	85	16.0	18,832
15016 Rotor Damper Assembly	Off	D.S.	1,042	16.0	1,541
24038 APP Clutch	Off	D.S.	1,563	16.0	1,027
57027 AFCS Servo Unit	Off	D.S.	1,887	16.0	856

APPENDIX IV

COMPONENT MAINTENANCE REQUIREMENTS

Tables XXXIV through XXXIX show the overall maintenance requirements of each of the six helicopter models as derived from analysis of field data. The criteria under which this data was developed and an explanation of the content and format of the tables can be found in the body of this report in the sections entitled Field Data Processing and Maintenance Requirements Analysis. The source of the data on each aircraft is as follows:

Model	Source
OH-58	Navy TH-57A (3-M System)
OH-6	Army OH-6A (TAMMS)
UH-1	Marine Corps UH-1E (3-M System)
AH-1	Marine Corps AH-1G, AH-1J (3-M System)
CH-47	Army CH-47 (TAMMS)
CH-54	Army CH-54A (TAMMS)

The data is as derived from the field records except that the average man-hours for component replacement has been adjusted, where necessary, to agree with the results of this analysis.

TABLE XXXIV. COMPONENT MAINTENANCE REQUIREMENTS, OH-58 HELICOPTER

ACTION / REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG MC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
14128 SWASH PLATE/SPRT ASSY										
REPAIR	ON	D	3.4	1.6	16.3	75.8	54.6	70.6	1	1
127 ADJST/ALIGN IMPROPER				*	3.1	14.5	12.5	16.1		
167 TORQUE INCORRECT				*	3.5	16.1	8.5	10.9		
410 LACK OF/IMPROP LUBE				*	1.0	4.9	1.7	2.3		
710 BRG FAILING/FAULTY				*	1.7	8.0	4.9	6.3		
730 LOOSE				*	2.8	12.9	11.3	14.6		
REPLACE	ON	D	6.2	2.1	3.5	16.1	21.5	27.8	2	2
135 BINDING/STUCK/JAMMED				*	0.7	3.2	2.6	3.3		
190 CRACKED				*	0.7	3.2	1.5	1.9		
246 IMPROP/FAULTY PAINT				*	1.0	4.8	7.9	10.2		
OTHER			0.7	0.9	1.7	8.0	1.2	1.6		
COMPONENT TOTAL			3.6	1.7	21.5	100.0	77.4	100.0		
14142 CYCLIC SERVC ACT										
CHECK	ON	O	1.3	1.4	9.4	21.4	12.1	9.5	3	3
799 NO DEFECT				*	9.4	21.4	12.1	9.5		
REPAIR	ON	O	2.3	1.5	21.8	50.0	49.3	38.6	1	1
029 CURRENT INCORRECT				*	1.4	3.2	0.7	0.5		
127 ADJST/ALIGN IMPROPER				*	2.1	4.8	6.3	4.9		
135 BINDING/STUCK/JAMMED				*	3.9	8.8	9.5	7.4		
230 DIRTY				*	2.1	4.8	6.8	5.3		
381 LEAKING-INTERN/EXTER				*	2.8	6.4	4.0	3.2		
803 NO-DEF/TIME CHANGE				*	2.1	4.8	7.8	6.1		
REPLACE	ON	O	2.5	1.6	12.5	28.6	31.2	24.4	2	2
381 LEAKING-INTERN/EXTER				*	8.3	19.1	13.1	10.2		
803 NO-DEF/TIME CHANGE				*	1.7	4.0	7.0	5.5		
OTHER			2.5	1.6	0.0	0.0	35.0	27.4		
COMPONENT TOTAL			2.9	1.5	43.7	100.0	127.6	100.0		

TABLE XXXIV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
14144 COLLECTIVE SERVO ACT										
REPAIR	ON	O	1.3	1.4	5.5	72.7	7.1	43.7	1	1
070 BROKEN				*	0.3	4.6	0.2	1.0		
127 ADJST/ALIGN IMPROPER				*	0.7	9.1	1.7	10.6		
135 BINDING/STUCK/JAMMED				*	0.3	4.6	0.2	1.0		
170 CORRODED				*	0.7	9.1	0.3	1.7		
381 LEAKING-INTERN/EXTER				*	0.3	4.6	0.3	2.1		
730 LOOSE				*	1.0	13.7	1.7	10.2		
803 NO-DEF/TIME CHANGE				*	1.7	22.8	2.6	15.9		
878 WEATHER DAMAGE				*	0.3	4.6	0.2	1.0		
REPLACE	ON	O	2.7	1.7	1.7	22.7	4.7	28.6	2	2
135 BINDING/STUCK/JAMMED				*	0.3	4.5	1.9	11.4		
381 LEAKING-INTERN/EXTER				*	1.0	13.6	1.7	10.3		
599 TRAVEL/EXT INCORRECT				*	0.3	4.5	1.1	6.9		
OTHER			12.9	1.7	0.3	4.6	4.5	27.7		
COMPONENT TOTAL			2.1	1.5	7.6	100.0	16.3	100.0		
15211 MAIN ROTOR HUB										
REPAIR	ON	O	7.6	2.3	29.8	89.6	225.8	75.4	1	1
105 LOOSE/DAMAG HARDWARE				*	1.7	5.2	1.6	0.5		
127 ADJST/ALIGN IMPROPER				*	1.7	5.2	27.3	9.1		
167 TORQUE INCORRECT				*	14.2	42.7	13.8	4.6		
381 LEAKING-INTERN/EXTER				*	9.7	29.2	165.7	55.3		
REPLACE	ON	O	7.4	2.2	2.1	6.2	15.4	5.1	2	2
803 NO-DEF/TIME CHANGE				*	1.7	5.2	13.3	4.4		
OTHER			42.1	2.1	1.4	4.2	58.5	19.5		
COMPONENT TOTAL			9.0	2.3	33.3	100.0	299.7	100.0		

TABLE XXXIV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
15114 HUB GRIP RESERVOIR										
REPAIR	ON	O	1.5	1.9	124.1	94.0	181.9	81.7	1	1
381 LEAKING-INTERN/EXTER				*	51.6	39.1	128.0	57.5		
410 LACK OF/IMPROP LUBE				*	55.1	41.7	32.7	14.7		
REPLACE	ON	O	0.7	2.9	5.9	4.5	4.1	1.9	2	2
801 NO-DEF/REMVD FOR MOD				*	4.2	3.1	0.7	0.3		
OTHER			17.6	3.0	2.1	1.6	36.7	16.5		
COMPONENT TOTAL			1.7	2.0	132.1	100.0	222.7	100.0		
15211 TAIL ROTOR HUB										
REPAIR	ON	O	1.6	1.3	13.9	75.5	22.6	50.6	1	1
020 WORN,CHAFED,FRAYED				*	0.7	3.8	0.5	1.2		
127 ADJST/ALIGN IMPROPER				*	2.1	11.3	1.7	3.8		
458 OUT OF BALANCE				*	1.4	7.5	7.6	17.1		
730 LOOSE				*	8.3	45.3	10.7	23.9		
REPLACE	ON	O	5.4	1.3	3.8	20.7	20.6	46.1	2	2
020 WORN,CHAFED,FRAYED				*	1.7	9.4	6.3	14.0		
730 LOOSE				*	0.7	3.8	4.3	9.6		
803 NO-DEF/TIME CHANGE				*	1.0	5.7	9.3	20.9		
OTHER			2.1	0.8	0.7	3.8	1.4	3.3		
COMPONENT TOTAL			2.4	1.3	18.4	100.0	44.6	100.0		
15215 TAIL ROTOR BLADE										
REPAIR	ON	O	1.8	1.4	10.1	52.8	18.5	29.3	1	2
106 MISSING HARDWARE				*	1.7	9.1	2.8	4.4		
117 DETERIORATED				*	2.1	10.9	1.7	2.6		
127 ADJST/ALIGN IMPROPER				*	0.7	3.6	2.9	4.7		
170 CORRODED				*	1.0	5.4	0.9	1.4		
458 OUT OF BALANCE				*	1.4	7.3	6.2	9.9		
730 LOOSE				*	1.4	7.3	1.0	1.6		
REPLACE	ON	O	4.4	1.4	8.7	45.5	38.1	60.5	2	1
020 WORN,CHAFED,FRAYED				*	0.7	3.6	1.6	2.6		
105 LOOSE/DAMAG HARDWARE				*	0.7	3.6	3.0	4.7		
458 OUT OF BALANCE				*	1.4	7.3	5.7	9.0		
710 BRG FAILING/FAULTY				*	0.7	3.6	3.0	4.7		
730 LOOSE				*	1.4	7.3	6.3	9.9		
780 BENT,BUCKLED,ETC				*	1.0	5.5	3.9	6.2		
801 NO-DEF/REMVD FOR MOD				*	0.7	3.6	0.8	1.2		
803 NO-DEF/TIME CHANGE				*	1.4	7.3	10.0	15.9		
OTHER			18.8	1.6	0.3	1.6	6.4	10.1		
COMPONENT TOTAL			3.3	1.4	19.1	100.0	63.0	100.0		

TABLE XXXIV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	Q-S-N-K MA/ FH	Q-S-N-K MH/ FH
22500 T63 ENGINE										
REPLACE	ON	D	28.9	2.1	21.1	76.2	611.2	86.9	1	1
306 CONTAMINATION				*	3.8	13.7	54.4	7.7		
372 METAL ON MAGNET PLUG				*	1.7	6.3	30.0	4.3		
374 INTERNAL FAILURE				*	1.7	6.3	27.5	3.9		
803 NO-DEF/TIME CHANGE				*	11.4	41.2	434.0	61.7		
OTHER			14.3	2.0	6.6	23.8	92.3	13.1		
COMPONENT TOTAL			25.4	2.1	27.7	100.0	703.5	100.0		
22561 FUEL PUMP										
REPAIR	ON	C	2.3	1.4	9.7	45.2	21.9	36.5	2	2
108 BROKEN SFTY WIRE/KEY				*	0.7	3.2	1.2	2.0		
230 DIRTY				*	1.4	6.5	1.9	3.2		
381 LEAKING-INTERN/EXTER				*	5.9	27.4	13.5	22.4		
730 LOOSE				*	0.7	3.2	0.7	1.1		
REPLACE		D	2.8	1.3	10.8	50.0	30.1	50.2	1	1
374 INTERNAL FAILURE				*	0.7	3.3	2.0	3.3		
381 LEAKING-INTERN/EXTER				*	10.1	46.8	28.1	46.9		
OTHER			7.7	1.3	1.0	4.8	8.0	13.3		
COMPONENT TOTAL			2.9	1.3	21.5	100.0	60.0	100.0		
22562 MAIN FUEL CONTROL										
REPAIR	ON	O	1.7	1.3	24.3	70.7	41.0	41.6	1	1
127 ADJST/ALIGN IMPROPER				*	17.7	51.5	30.8	31.2		
381 LEAKING-INTERN/EXT..				*	3.5	10.1	5.2	5.2		
INSTALL	ON		1.8	1.2	0.7	2.0	8.8	9.0	3	3
REPLACE	ON	D	3.4	1.4	8.3	24.2	28.3	28.7	2	2
177 FUEL FLOW INCORRECT				*	1.0	3.0	1.4	1.4		
242 NO OPER,REAS UNKNOWN				*	4.2	12.1	15.6	15.8		
374 INTERNAL FAILURE				*	2.1	6.1	6.5	6.6		
OTHER			19.6	1.4	1.0	3.1	20.5	20.8		
COMPONENT TOTAL			2.9	1.3	34.3	100.0	98.7	100.0		

TABLE XXXIV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L S V	MH/ MA AVG	AVG AC PER	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
22563 GOVERNOR										
REPAIR	ON	C	2.0	1.3	10.8	57.4	21.3	45.2	1	2
127 ADJST/ALIGN IMPROPER				*	2.1	11.1	3.8	8.1		
381 LEAKING-INTERN/EXTER				*	6.2	33.3	14.1	29.9		
REPLACE	ON	D	3.0	1.1	7.6	40.7	22.9	48.6	2	1
242 NO OPER,REAS UNKNOWN				*	6.2	33.3	16.9	36.0		
374 INTERNAL FAILURE				*	0.7	3.7	2.1	4.4		
OTHER			8.3	1.5	0.3	1.9	2.9	6.2		
COMPONENT TOTAL			2.5	1.2	18.7	100.0	47.1	100.0		
22566 FUEL CHECK VALVE										
REPAIR	ON	O	1.0	1.0	4.2	40.0	4.3	34.5	2	2
037 FLUCTUATES/ERRATIC				*	0.3	3.3	0.2	1.4		
108 BROKEN SFTY WIRE/KEY				*	0.7	6.7	0.5	4.2		
230 DIRTY				*	0.7	6.7	1.4	11.2		
242 NO OPER,REAS UNKNOWN				*	0.7	6.7	0.8	6.7		
246 IMPROP/FAULTY PAINT				*	0.3	3.3	0.2	1.4		
315 RPM FLUCTUATION				*	0.7	6.7	0.7	5.6		
730 LOOSE				*	0.3	3.3	0.2	1.4		
803 NO-DEF/TIME CHANGE				*	0.3	3.3	0.3	2.8		
REPLACE	ON	O	2.2	1.2	6.2	60.0	13.7	110.3	1	1
037 FLUCTUATES/ERRATIC				*	1.7	16.7	6.1	49.3		
070 BROKEN				*	0.3	3.4	0.6	4.7		
167 TORQUE INCORRECT				*	0.3	3.4	0.6	4.7		
242 NO OPER,REAS UNKNOWN				*	1.7	16.7	3.5	28.1		
374 INTERNAL FAILURE				*	1.4	13.3	2.3	18.7		
803 NO-DEF/TIME CHANGE				*	0.7	6.7	0.6	4.7		
COMPONENT-TOTAL			1.7	1.1	10.4	100.0	18.0	100.0		

TABLE XXXIV - Continued

ACTION REASON/FAILURE MOD-	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
22572 LUBE FILTER										
REPAIR	ON	0	2.5	1.2	8.7	80.7	21.8	88.7	1	1
127 ADJUST/ALIGN IMPROPER				*	1.4	12.9	1.7	7.0		
306 CONTAMINATION				*	2.8	25.8	5.5	22.5		
372 METAL ON MAGNET PLUG				*	3.1	29.0	6.8	27.5		
REPLACE	ON	0	1.2	1.5	2.1	19.3	2.5	10.2	2	2
306 CONTAMINATION				*	0.3	3.2	0.9	3.8		
372 METAL ON MAGNET PLUG				*	0.7	6.4	0.9	3.8		
803 NO-DEF/TIME CHANGE				*	1.0	9.7	0.6	2.5		
OTHER			1.2	1.1	0.0	0.0	0.3	1.1		
COMPONENT TOTAL			2.3	1.2	10.8	100.0	24.6	100.0		
22593 IGNITION LEAD										
REPAIR	ON	0	1.1	1.4	1.0	37.5	1.1	21.5	2	2
070 BROKEN				*	0.3	12.5	0.7	13.0		
105 LOOSE/DAMAG HARDWARE				*	0.3	12.5	0.3	6.5		
127 ADJUST/ALIGN IMPROPER				*	0.3	12.5	0.1	2.0		
REPLACE	ON	0	1.7	2.4	1.7	62.5	2.9	55.4	1	1
020 WORN,CHAFED,FRAYED				*	0.3	12.5	0.4	6.9		
242 NO OPER,REAS UNKNOWN				*	0.7	25.0	1.7	32.3		
350 INSULATION BREAKDOWN				*	0.3	12.5	0.6	11.5		
947 TORN				*	0.3	12.5	0.2	4.6		
OTHER			1.7	0.5	0.0	0.0	1.2	23.2		
COMPONENT TOTAL			1.9	1.2	2.8	100.0	5.3	100.0		
26111 ENG TO XMSN DRIVE SHAFT										
REPAIR	ON	0	4.0	1.3	27.0	80.4	108.8	76.5	1	1
381 LEAKING-INTERN/EXTER				*	6.6	19.6	27.1	19.0		
804 NO-DEF/SCHED MAINT				*	16.6	49.5	69.7	49.0		
REPLACE	ON	0	3.9	1.2	5.9	17.5	23.0	16.1	2	2
020 WORN,CHAFED,FRAYED				*	1.0	3.1	5.6	3.9		
381 LEAKING-INTERN/EXTER				*	1.0	3.1	4.8	3.4		
803 NO-DEF/TIME CHANGE				*	3.1	9.3	12.0	8.4		
OTHER			15.3	1.2	0.7	2.1	10.5	7.4		
COMPONENT TOTAL			4.2	1.3	33.6	100.0	142.2	100.0		

TABLE XXXIV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
26210 MAIN XMSN ASSY										
REPAIR	ON	O	3.8	1.6	9.0	53.1	34.7	14.9	1	2
306 CONTAMINATION				*	2.8	16.4	8.6	3.7		
381 LEAKING-INTERN/EXTER				*	5.5	32.7	22.9	9.8		
REPLACE	ON	O	13.9	2.1	6.2	36.7	86.7	37.2	2	1
381 LEAKING-INTERN/EXTER				*	0.7	4.1	2.7	1.2		
803 NO-DEF/TIME CHANGE				*	2.4	14.2	42.6	18.3		
804 NO-DEF/SCHED MAINT				*	2.8	16.3	33.7	14.4		
OTHER			64.7	2.2	1.7	10.2	111.8	47.9		
COMPONENT TOTAL			13.7	2.0	17.0	100.0	233.3	100.0		
26411 DRIVE COUPLING										
REPAIR	ON		0.9	1.1	5.5	84.2	5.3	54.8	1	1
106 MISSING HARDWARE				*	0.3	5.3	1.4	14.4		
170 CORRODED				*	3.1	47.4	1.5	15.1		
246 IMPROP/FAULTY PAINT				*	1.0	15.8	0.5	5.4		
437 IMPROP POSTND/SLCTD				*	0.3	5.3	0.2	1.8		
730 LOOSE				*	0.7	10.5	1.7	18.0		
REPLACE	ON	O	0.6	1.2	1.0	15.8	0.6	6.5	2	2
020 WORN,CHAFED,FRAYED				*	0.7	10.5	0.6	5.9		
780 BENT,BUCKLED,ETC				*	0.3	5.3	0.0	0.5		
OTHER			0.6	1.2	0.0	0.0	3.7	38.7		
COMPONENT TOTAL			1.5	1.1	6.6	100.0	9.6	100.0		
26413 BEARING HANGER										
REPAIR	ON	O	2.0	1.4	21.1	80.3	43.3	68.9	1	1
0 8 NOISY				*	4.5	17.1	16.1	25.6		
020 WORN,CHAFED,FRAYED				*	3.5	13.2	9.0	14.3		
730 LOOSE				*	8.7	32.9	11.2	17.9		
REPLACE	ON	O	2.6	1.4	4.5	17.1	12.6	20.1	2	2
0 8 NOISY				*	2.1	7.9	2.3	3.6		
020 WORN,CHAFED,FRAYED				*	0.7	2.6	2.4	3.9		
710 BRG FAILING/FAULTY				*	0.7	2.6	3.8	6.0		
OTHER			10.0	1.3	0.7	2.6	6.9	11.0		
COMPONENT TOTAL			2.4	1.4	26.3	100.0	62.8	100.0		

TABLE XXXIV - Continued

ACTION REASON/FAILURE MODE	ON/OFF A/C	L E V	MH/MA AVG	AVG AC PER	MA/FH RATE	MA/FH PCNT	MH/FH RATE	MH/FH PCNT	R-A-M-R MA/FH	R-A-M-R MH/FH
26416 TAIL ROTOR GEARBOX										
REPAIR	ON	C	3.1	1.5	33.2	94.2	94.3	76.9	1	1
306 CONTAMINATION				*	2.8	7.9	3.7	3.0		
381 LEAKING-INTERN/EXTER				*	21.8	62.4	78.8	64.1		
REPLACE	ON	C	4.7	1.5	3.1	8.9	14.7	11.9	2	2
5[illegible] NO-DEF/TIME CHANGE				*	1.7	5.0	9.7	7.9		
OTHER			5.0	1.5	1.7	4.9	13.8	11.2		
COMPONENT TOTAL			3.5	1.5	35.0	100.0	122.6	100.0		
29310 PWR/DROOP COMP CNTRL										
REPLACE	ON	C	2.1	1.4	3.5	100.0	7.3	100.0	1	1
315 RPM FLUCTUATION				*	0.3	10.0	0.8	13.7		
127 ADJUST/ALIGN IMPROPER				*	3.1	90.0	6.5	86.4		
COMPONENT TOTAL			2.1	1.4	3.5	100.0	7.3	100.0		
29411 OIL COOLER										
REPAIR	ON	O	1.0	1.2	3.5	35.7	3.4	11.9	2	2
190 CRACKED				*	0.3	3.6	0.2	0.6		
230 DIRTY				*	0.7	7.1	0.3	1.1		
246 IMPROP/FAULTY PAINT				*	0.3	3.6	1.0	3.6		
381 LEAKING-INTERN/EXTER				*	0.7	7.1	1.2	4.1		
437 IMPROP POSTNG/ALCTD				*	0.3	3.6	0.2	0.6		
760 BENT,BUCKLED,ETC				*	0.7	7.1	0.3	1.2		
947 TORN				*	0.3	3.6	0.2	0.6		
REPLACE	ON	O	3.8	1.5	5.9	60.7	22.4	77.9	1	1
306 CONTAMINATION				*	3.1	32.1	16.5	57.5		
372 METAL ON MAGNET PLUG				*	0.3	3.6	0.8	2.8		
374 INTERNAL FAILURE				*	0.3	3.6	0.6	2.3		
381 LEAKING-INTERN/EXTER				*	2.1	21.4	4.4	15.3		
OTHER			8.4	1.3	0.3	3.6	2.9	10.2		
COMPONENT TOTAL			3.0	1.4	9.7	100.0	28.6	100.0		

TABLE XXXIV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
29711 ANTI-ICING CNTRL/ACT										
CHECK	ON	0	0.8	1.7	1.0	23.1	0.9	8.8	3	3
799 NO DEFECT				*	1.0	23.1	0.9	8.8		
REPAIR	ON	C	1.1	1.3	1.4	30.8	1.6	15.8	2	2
135 BINDING/STUCK/JAMMED				*	0.7	15.4	1.0	10.5		
230 DIRTY				*	0.3	7.7	0.3	3.5		
730 LOOSE				*	0.3	7.7	0.2	1.8		
REPLACE	ON	0	2.2	1.8	2.1	46.1	4.6	46.4	1	1
0 8 NOISY				*	0.3	7.7	1.4	14.0		
020 WORN,CHAFED,FRAYED				*	0.3	7.7	0.2	2.2		
242 NO OPER,REAS UNKNOWN				*	1.4	30.8	3.0	30.2		
OTHER			2.2	1.8	0.0	0.0	2.9	29.0		
COMPONENT TOTAL			2.2	1.7	4.5	100.0	9.9	100.0		
42111 STARTER/GENERATOR										
CHECK	ON	C	2.3	1.7	5.9	6.0	13.3	6.5	3	3
799 NO DEFECT				*	5.9	6.0	13.3	6.5		
REPAIR	ON	C	1.7	1.5	54.1	55.3	90.9	44.1	1	1
230 DIRTY				*	4.5	4.6	10.1	4.9		
381 LEAKING-INTERN/EXTER				*	31.9	32.6	35.9	17.4		
REPLACE	ON	C	2.0	1.6	37.1	37.9	74.2	36.0	2	2
070 BROKEN				*	3.1	3.2	4.7	2.3		
242 NO OPER,REAS UNKNOWN				*	12.8	13.1	31.5	15.3		
585 SHEARED				*	6.9	7.1	13.9	6.8		
720 BRUSH FAILING/WORN				*	6.9	7.1	11.9	5.8		
OTHER			39.6	1.4	0.7	0.7	27.8	13.5		
COMPONENT TOTAL			2.1	1.5	97.6	100.0	206.2	100.0		

TABLE XXXV. COMPONENT MAINTENANCE REQUIREMENTS, OH-6 HELICOPTER

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
14032 SWASHPLATE										
REPLACE	ON	D	7.2		9.0	75.2	64.7	54.6	1	1
020 WORN,CHAFED,FRAYED				*	3.6	29.9				
170 CORRODED				*	1.4	12.0				
803 NO-DEF/TIME CHANGE				*	3.3	27.9	16.3	13.8		
800 NO-DEF/OTHER MAINT				*	0.8	6.5				
799 NO DEFECT				*	0.3	2.8				
OTHER			18.2		3.0	24.8	53.8	45.4		
COMPONENT TOTAL			9.9		11.9	100.0	118.4	100.0		
15003 HUB ASSY -TAIL ROTOR										
CHECK	OFF	O	2.0		24.8	10.4	49.7	2.1	2	3
ADJUST	ON	D	4.2		7.0	2.9	29.1	1.2	4	4
127 ADJST/ALIGN IMPROPER				*	3.3	1.4				
458 OUT OF BALANCE				*	1.5	0.6				
690 VIBRATION EXCESSIVE				*	1.3	0.6				
REPAIR	ON	D	4.3		1.1	0.5	4.8	0.2	5	5
REPAIR	OFF	D	10.0		107.7	45.4	1077.3	45.0	1	1
020 WORN,CHAFED,FRAYED				*	14.0	5.9				
190 CRACKED				*	11.8	5.0				
070 BROKEN				*	14.0	5.9				
REMOVE	ON	D	5.7		0.3	0.1	1.7	0.1	6	6
REPLACE	ON	D	3.2		23.3	9.8	74.7	3.1	3	2
190 CRACKED				*	4.4	1.9				
070 BROKEN				*	1.3	0.6				
799 NO DEFECT				*	1.6	0.7				
020 WORN,CHAFED,FRAYED				*	4.1	1.7				
800 NO-DEF/OTHER MAINT				*	1.4	0.6				
804 NO-DEF/SCHED MAINT				*	1.0	0.4				
OTHER			15.8		73.2	30.8	1154.0	48.3		
COMPONENT TOTAL			10.1		237.5	100.0	2391.4	100.0		

TABLE XXXV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
15010 HUB ASSY-MAIN ROTOR										
CHECK	OFF	O	2.0		8.5	9.3	17.1	2.3	3	3
799 NO DEFECT				*	3.1	3.4				
REPAIR	OFF	D	8.0		54.1	59.2	433.5	57.3	1	1
020 WORN,CHAFED,FRAYED				*	8.4	9.2				
731 BATTLE DAMAGE				*	8.4	9.2				
REPLACE	ON	D	8.3		15.1	16.5	125.2	16.5	2	2
020 WORN,CHAFED,FRAYED				*	3.7	4.1				
OTHER			13.2		13.7	15.0	180.6	23.9		
COMPONENT TOTAL			8.3		91.4	100.0	756.4	100.0		
15047 DAMPER-MAIN ROTOR										
REPLACE	ON	O	1.2		31.6	93.6	38.0	52.5	1	1
374 INTERNAL FAILURE				*	2.1	6.2				
381 LEAKING-INTERN/EXTER				*	6.3	18.6				
020 WORN,CHAFED,FRAYED				*	10.0	29.6				
167 TORQUE INCORRECT				*	2.1	6.2				
127 ADJST/ALIGN IMPROPER				*	1.9	5.5				
OTHER			15.8		2.2	6.4	34.3	47.5		
COMPONENT TOTAL			2.1		33.8	100.0	72.3	100.0		
15153 BLADE TAIL ROTOR										
ADJUST	ON	O	2.0		0.3	6.8	0.6	6.6	2	2
127 ADJST/ALIGN IMPROPER				*	0.3	6.8				
REPAIR	OFF		1.[illegible]		0.3	6.8	0.5	5.6	3	3
REPLACE	ON	D	3.8		2.1	47.3	8.0	86.4	1	1
799 NO DEFECT				*	0.1	3.0				
070 BROKEN				*	0.4	9.3				
804 NO-DEF/SCHED MAINT				*	0.1	3.0				
731 BATTLE DAMAGE				*	0.1	3.0				
020 WORN,CHAFED,FRAYED				*	0.3	6.1				
537 LOW POWER OR THRUST				*	0.1	3.0				
730 LOOSE				*	0.1	3.0				
780 BENT,BUCKLED,ETC				*	0.3	6.1				
190 CRACKED				*	0.6	13.5				
799 NO DEFECT				*	0.2	4.5				
OTHER			0.1		1.7	39.2	0.1	1.4		
COMPONENT TOTAL			2.1		4.4	100.0	9.2	100.0		

TABLE XXXV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
22007 ENGINE TURBINE										
CHECK	ON	O	40.8		0.4	0.3	16.3	1.0	8	7
CHECK	OFF	D	3.0		22.7	15.8	69.8	4.2	3	3
ADJUST	ON	O	2.6		10.5	7.3	27.9	1.7	5	5
127 ADJUST/ALIGN IMPROPER				*	6.1	4.2				
REPAIR	ON	D	5.9		11.3	7.9	66.9	4.1	4	4
REPAIR	OFF	D	10.0		72.1	50.0	721.1	44.3	1	2
381 LEAKING-INTERN/EXTER				*	6.9	4.8				
731 BATTLE DAMAGE				*	11.1	7.7				
REMOVE	ON	D	9.9		2.4	1.7	24.2	1.5	6	6
INSTALL	ON	D	8.3		1.6	1.1	13.0	0.8	7	8
REPLACE	ON	D	14.5		59.2	41.1	858.3	52.7	2	1
020 WORN,CHAFED,FRAYED				*	2.0	1.4				
070 BROKEN				*	2.4	1.7				
142 ENG REM,EXCESS MAINT				*	0.6	0.4				
190 CRACKED				*	1.7	1.1				
230 DIRTY				*	0.1	0.1				
304 UNIDENTIFIED BY CODE				*	1.6	1.1				
317 HOT START				*	1.6	1.1				
374 INTERNAL FAILURE				*	4.7	3.2				
381 LEAKING-INTERN/EXTER				*	6.3	4.4				
799 NO DEFECT				*	5.2	3.6				
800 NO-DEF/OTHER MAINT				*	4.8	3.3				
803 NO-DEF/TIME CHANGE				*	3.2	2.2				
804 NO-DEF/SCHED MAINT				*	2.5	1.8				
COMPONENT TOTAL			10.0		183.3	100.0	1796.5	100.0		

TABLE XXXV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
22044 GOVERNOR POWER										
ADJUST	ON	O	2.0		2.1	14.3	4.1	5.6	2	2
127 ADJST/ALIGN IMPROPER				*	1.4	9.5				
REPLACE	ON	O	3.5		9.7	65.3	33.9	46.3	1	1
020 WORN,CHAFED,FRAYED				*	0.2	1.3				
037 FLUCTUATES/ERRATIC				*	0.9	5.9				
070 BROKEN				*	0.2	1.3				
135 BINDING/STUCK/JAMMED				*	0.3	2.2				
374 INTERNAL FAILURE				*	2.6	17.9				
799 NO DEFECT				*	0.4	2.6				
800 NO-DEF/OTHER MAINT				*	0.3	2.0				
801 NO-DEF/REMVD FOR MOD				*	0.2	1.3				
803 NO-DEF/TIME CHANGE				*	1.8	12.3				
804 NO-DEF/SCHED MAINT				*	0.3	1.9				
OTHER			12.4		2.8	19.4	35.3	48.2		
COMPONENT TOTAL			5.0		14.6	100.0	73.4	100.0		
22054 FUEL CONTROL										
CHECK	OFF	O	1.0		4.7	18.1	4.7	3.6	2	2
ADJUST	ON	O	2.1		2.2	8.4	4.6	3.4	3	3
127 ADJST/ALIGN IMPROPER				*	1.7	6.6				
REPLACE	ON	O	3.6		15.8	60.5	56.9	43.0	1	1
020 WORN,CHAFED,FRAYED				*	0.5	1.3				
037 FLUCTUATES/ERRATIC				*	1.2	4.4				
070 BROKEN				*	0.6	2.3				
127 ADJST/ALIGN IMPROPER				*	0.7	2.5				
177 FUEL FLOW INCORRECT				*	0.3	1.1				
374 INTERNAL FAILURE				*	5.4	20.8				
803 NO-DEF/TIME CHANGE				*	0.8	2.9				
962 LOWER POWER ELECTRON				*	0.4	1.5				
OTHER			19.4		3.4	13.0	66.1	50.0		
COMPONENT TOTAL			5.1		26.1	100.0	132.3	100.0		

TABLE XXXV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
22060 COOLER ASSEMBLY-OIL										
REPAIR	ON	C	6.4		0.4	6.5	2.8	5.7	2	2
070 BROKEN				*	0.1	1.3				
190 CRACKED				*	0.4	5.2				
REPLACE	ON	D	5.1		6.2	91.8	31.8	65.1	1	1
020 WORN,CHAFED,FRAYED				*	0.3	4.5				
070 BROKEN				*	0.9	13.8				
135 BINDING/STUCK/JAMMED				*	0.3	4.5				
190 CRACKED				*	0.8	12.4				
381 LEAKING-INTERN/EXTER				*	1.7	24.9				
799 NO DEFECT				*	0.3	4.7				
800 NO-DEF/OTHER MAINT				*	0.7	10.0				
804 NO-DEF/SCHED MAINT				*	0.3	4.7				
OTHER			119.0		0.1	1.8	14.3	29.2		
COMPONENT TOTAL			7.2		6.8	100.0	48.9	100.0		
22110 FILTER ENGINE OIL										
REPLACE	ON	O	0.7		12.5	73.9	8.8	47.1	1	1
020 WORN,CHAFED,FRAYED				*	0.5	2.9				
070 BROKEN				*	0.2	1.2				
125 UNIDENTIFIED BY CODE				*	1.1	6.5				
230 DIRTY				*	3.3	19.3				
799 NO DEFECT				*	2.0	11.7				
800 NO-DEF/OTHER MAINT				*	1.0	5.8				
804 NO-DEF/SCHED MAINT				*	1.7	9.9				
OTHER			2.2		4.4	26.1	9.9	52.9		
COMPONENT TOTAL			1.1		17.0	100.0	18.6	100.0		
26012 TRANSMISSION-MAIN ROTOR										
CHECK	OFF	C	1.9		11.9	9.2	23.0	2.7	3	3
REPAIR	OFF	D	7.0		56.6	43.6	398.9	47.3	1	2
372 METAL ON MAGNET PLUG				*	3.6	2.8				
731 BATTLE DAMAGE				*	7.1	5.5				
931 INADVERT OPER/RCLSE				*	9.3	7.1				

TALLE XXXV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
REPLACE	ON	D	15.6		27.5	21.2	429.5	50.9	2	1
020 WORN,CHAFED,FRAYED				*	2.6	2.0				
070 BROKEN				*	0.1	0.1				
306 CONTAMINATION				*	0.1	0.1				
330 EXCESSIVE HUM				*	0.1	0.1				
372 METAL ON MAGNET PLUG				*	1.8	1.4				
374 INTERNAL FAILURE				*	2.3	1.8				
464 OVERSPEED				*	0.3	0.2				
799 NO DEFECT				*	2.9	2.3				
800 NO-DEF/OTHER MAINT				*	2.2	1.7				
603 NO-DEF/TIME CHANGE				*	4.4	3.4				
804 NO-DEF/SCHED MAINT				*	3.5	2.7				
OTHER			0.0		33.8	26.0	0.0	0.0		
COMPONENT TOTAL			6.6		129.8	100.0	851.4	100.0		
26017 TRANSMISSION-TAIL ROTOR										
CHECK	OFF	D	1.0		22.2	17.5	22.2	4.4	3	3
799 NO DEFECT				*	8.7	6.9				
REPAIR	OFF	D	4.0		51.3	40.4	206.4	40.6	1	2
381 LEAKING-INTERN/EXTER				*	11.9	9.3				
REPLACE	ON	D	6.7		34.7	27.3	232.4	45.7	2	1
020 WORN,CHAFED,FRAYED				*	3.3	2.6				
381 LEAKING-INTERN/EXTER				*	4.9	3.8				
799 NO DEFECT				*	4.9	3.8				
800 NO-DEF/OTHER MAINT				*	3.5	2.7				
803 NO-DEF/TIME CHANGE				*	3.5	2.8				
804 NO-DEF/SCHED MAINT				*	1.3	1.0				
OTHER			2.5		18.9	14.9	47.4	9.3		
COMPONENT TOTAL			4.0		127.1	100.0	508.5	100.0		

TABLE XXXV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
26019 DRIVE SHAFT-MAIN										
CHECK	OFF	D	1.0		23.3	29.8	23.3	10.0	1	2
REPLACE	ON	D	2.4		22.9	29.3	55.0	23.5	2	1
020 WORN,CHAFED,FRAYED				*	1.7	2.1				
799 NO DEFECT				*	4.8	6.1				
170 CORRODED				*	0.4	0.5				
800 NO-DEF/OTHER MAINT				*	8.3	10.6				
804 NO-DEF/SCHED MAINT				*	2.7	3.4				
935 SCORED OR SCRATCHED				*	0.3	0.4				
OTHER			4.8		32.1	41.0	155.4	66.5		
COMPONENT TOTAL			3.0		78.3	100.0	233.7	100.0		
26023 SHAFT-TAIL ROTOR DRIVE										
CHECK	ON	C	0.8		5.8	5.7	4.5	2.2	4	4
CHECK	OFF	D	1.0		20.3	19.8	20.3	9.7	2	3
REPAIR	OFF	D	2.0		47.2	45.9	93.2	44.5	1	1
REPLACE	ON	D	3.7		20.1	19.5	74.4	35.5	3	2
020 WORN,CHAFED,FRAYED				*	2.0	1.9				
093 MISSING PART				*	0.5	0.5				
731 BATTLE DAMAGE				*	0.9	0.9				
500 UNIDENTIFIED BY CODE				*	0.5	0.5				
585 SHEARED				*	0.5	0.5				
780 BENT,BUCKLED,ETC				*	0.9	0.8				
799 NO DEFECT				*	5.8	5.7				
800 NO-DEF/OTHER MAINT				*	3.2	3.1				
804 NO-DEF/SCHED MAINT				*	1.6	1.5				
OTHER			1.8		9.4	9.1	16.8	8.0		
COMPONENT TOTAL			2.0		102.8	100.0	209.2	100.0		

TABLE XXXV - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
26126 SEAL BEARING										
REPLACE	ON	0	3.7		4.9	100.0	18.1	113.1	1	1
381 LEAKING-INTERN/EXTER				*	3.8	78.4				
020 WORN,CHAFED,FRAYED				*	0.7	13.5				
COMPONENT TOTAL			3.7		4.9	100.0	18.1	100.0		
26187 FILTER-MAIN TRANSMISSION										
REPLACE	ON	0	1.0		6.0	91.8	6.0	104.7	1	1
799 NO DEFECT				*	1.2	19.0				
135 BINDING/STUCK/JAMMED				*	0.8	11.6				
020 WORN,CHAFED,FRAYED				*	0.2	3.8				
230 DIRTY				*	2.0	30.3				
070 BROKEN				*	0.5	7.6				
804 NO-DEF/SCHED MAINT				*	0.5	7.6				
OTHER			0.0		0.5	8.2	0.0	0.0		
COMPONENT TOTAL			0.9		6.5	100.0	6.0	100.0		
42055 STARTER GENERATOR										
REPLACE	ON	0	1.2		14.3	82.0	17.1	26.9	1	1
374 INTERNAL FAILURE				*	2.7	15.4				
020 WORN,CHAFED,FRAYED				*	0.8	4.5				
900 BURNED OR OVERHEATED				*	0.9	5.1				
080 BURNED OUT LGHT BULB				*	0.9	5.1				
720 BRUSH FAILING/WORN				*	0.8	4.5				
070 BROKEN				*	1.2	6.9				
OTHER			14.8		3.1	18.0	46.5	73.1		
COMPONENT TOTAL			3.7		17.4	100.0	63.7	100.0		

TABLE XXXVI. COMPONENT MAINTENANCE REQUIREMENTS, UH-1 HELICOPTER

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
14118 COLLECTIVE PITCH ASSY										
REPAIR	ON	O	1.9	1.3	15.7	50.3	30.3	47.0	1	1
020 WORN,CHAFED,FRAYED				*	8.9	28.5	18.4	28.5		
127 ADJST/ALIGN IMPROPER				*	1.3	4.1	2.4	3.7		
660 STRIPPED				*	0.8	2.6	0.7	1.1		
730 LOOSE				*	2.1	6.7	5.3	8.2		
REMOVE	ON	O	2.5	1.4	2.1	6.7	5.3	8.3	4	4
799 NO DEFECT				*	2.1	6.7	5.3	8.3		
INSTALL	ON	C	2.3	1.3	2.4	7.8	5.5	8.5	3	3
799 NO DEFECT				*	1.9	6.2	4.6	7.1		
REPLACE	ON	O	2.1	1.4	7.8	24.9	16.3	25.3	2	2
020 WORN,CHAFED,FRAYED				*	5.7	18.1	11.5	17.9		
OTHER			2.2	1.2	3.2	10.3	7.1	11.0		
COMPONENT TOTAL			2.1	1.3	31.2	100.0	64.5	100.0		
14128 CYCLIC SWSH PLT/SLP ASSY										
REPAIR	ON	O	3.4	1.5	21.3	46.7	73.4	33.3	1	2
127 ADJST/ALIGN IMPROPER				*	7.0	15.2	28.6	13.0		
REPLACE	ON	O	10.0	2.2	12.6	27.6	126.1	57.2	2	1
OTHER			1.2	1.8	11.8	25.8	21.1	9.6		
COMPONENT TOTAL			4.8	1.9	45.8	100.0	220.6	100.0		
14141 FLT CNTRLCYL/CONT VALVE										
REPAIR	ON	C	2.5	1.8	84.9	32.9	208.7	26.9	1	2
127 ADJST/ALIGN IMPROPER				*	20.2	7.8	57.8	7.4		
381 LEAKING-INTERN/EXTER				*	13.1	5.1	30.1	3.9		
710 BRG FAILING/FAULTY				*	7.5	2.9	9.6	1.2		
730 LOOSE				*	8.4	3.3	36.1	4.6		
INSTALL	ON	C	4.2	2.1	12.9	5.0	54.3	7.0	3	3
799 NO DEFECT				*	12.5	4.8	53.2	6.8		
REPLACE	ON	C	3.8	1.9	73.9	28.6	280.8	36.1	2	1
381 LEAKING-INTERN/EXTER				*	41.2	16.0	177.5	22.8		
800 NO-DEF/OTHER MAINT				*	8.9	3.4	26.4	3.4		
OTHER			2.7	1.6	86.7	33.5	233.0	30.0		
COMPONENT TOTAL			3.0	1.8	258.4	100.0	776.8	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-M-K MA/ FH	MH/ FH
15110 SCISSORS/SLEEVE ASSY										
REPAIR	ON	O	2.0	1.4	24.1	21.5	47.4	18.5	2	2
020 WORN,CHAFED,FRAYED				*	11.5	10.3	23.7	9.3		
127 ADJST/ALIGN IMPROPER				*	2.9	2.6	7.5	2.9		
REPLACE	ON	O	5 7	1.7	43.7	39.0	248.9	97.4	1	1
020 WORN,CHAFED,FRAYED				*	30.6	27.3	139.4	54.5		
710 BRG FAILING/FAULTY				*	3.5	3.2	11.2	4.4		
803 NO-DEF/TIME CHANGE				*	4.4	3.9	67.9	26.6		
OTHER			0.0		44.1	39.5	0.0	0.0		
COMPONENT TOTAL			2.6	1.6	111.9	100.0	296.2	100.0		
15115 MAIN ROTOR HUB ASSY										
REPAIR	OFF	O	17.8	2.0	14.4	14.9	255.1	30.7	2	2
020 WORN,CHAFED,FRAYED				*	3.2	3.4	83.5	10.0		
710 BRG FAILING/FAULTY				*	6.0	6.2	123.7	14.9		
REPLACE	ON	O	11.1	2.6	33.6	34.9	373.4	44.8	1	1
020 WORN,CHAFED,FRAYED				*	6.6	6.9	67.2	8.1		
190 CRACKED				*	4.4	4.5	52.6	6.3		
710 BRG FAILING/FAULTY				*	3.6	3.7	42.9	5.2		
803 NO-DEF/TIME CHANGE				*	3.7	3.9	38.8	4.7		
OTHER			4.2	2.0	48.3	50.2	203.5	24.4		
COMPONENT TOTAL			8.6	2.2	96.4	100.0	833.1	100.0		
15118 MAIN ROTOR CNT WT ASSY										
REPAIR	ON	O	2.0	1.5	3.6	62.9	7.2	72.5	1	1
020 WORN,CHAFED,FRAYED				*	0.5	8.6	0.5	4.9		
070 BROKEN				*	0.3	5.7	0.5	4.6		
127 ADJST/ALIGN IMPROPER				*	0.8	14.3	0.8	8.2		
135 BINDING/STUCK/JAMMED				*	0.3	5.7	0.2	1.7		
410 LACK OF/IMPROP LUBE				*	0.3	5.7	0.1	1.0		
REPLACE	ON	O	1.4	1.6	1.1	20.0	1.6	16.0	2	2
020 WORN,CHAFED,FRAYED				*	0.2	2.9	0.2	2.3		
070 BROKEN				*	0.8	14.3	0.9	9.0		
730 LOOSE				*	0.2	2.9	0.5	4.6		
OTHER			1.2	1.2	1.0	17.1	1.1	11.5		
COMPONENT TOTAL			1.7	1.5	5.7	100.0	9.9	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L C V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
15211 TAIL ROTOR HUB ASSY										
REPAIR	ON	D	1.9	1.4	18.8	10.2	36.0	7.9	3	3
REPAIR	OFF	D	3.9	1.2	40.1	21.9	156.3	34.3	2	2
710 BRG FAILING/FAULTY				*	28.2	15.4	127.3	27.9		
REPLACE	ON	D	3.5	1.3	77.1	42.1	270.0	59.2	1	1
710 BRG FAILING/FAULTY				*	32.0	17.5	105.3	23.1		
800 NO-DEF/OTHER MAINT				*	16.0	8.8	54.0	11.8		
OTHER			0.0		47.2	25.8	0.0	0.0		
COMPONENT TOTAL			2.5	1.3	183.2	100.0	462.2	100.0		
15212 TAIL ROTOR BLADE ASSY										
REMOVE	ON	D	0.8	1.2	13.4	13.2	11.2	8.4	2	3
799 NO DEFECT				*	13.4	13.2	11.2	8.4		
INSTALL	ON	D	1.1	1.2	11.6	11.4	13.3	9.9	3	2
799 NO DEFECT				*	11.6	11.4	13.3	9.9		
REPLACE	ON	D	3.7	1.2	61.1	59.9	226.2	165.4	1	1
301 FOREIGN OBJCT DAMAGE				*	5.2	5.1	21.0	15.7		
425 NICKED				*	4.7	4.6	14.2	10.6		
731 BATTLE DAMAGE				*	10.5	10.3	25.3	18.9		
780 BENT,BUCKLED,ETC				*	15.8	15.5	62.9	45.8		
800 NO-DEF/OTHER MAINT				*	11.6	11.4	50.0	37.2		
OTHER			0.0		15.8	15.5	0.0	0.0		
COMPONENT TOTAL			2.5	1.2	122.0	100.0	250.7	100.0		
22200 T53 ENGINE										
REPAIR	ON	D	2.3	1.4	31.7	25.2	71.5	6.2	2	3
127 ADJST/ALIGN IMPROPER				*	9.9	7.8	21.6	1.9		
170 CORRODED				*	2.6	2.1	9.7	0.8		
230 DIRTY				*	4.5	3.6	8.0	0.7		
334 TEMPERATURE INCORRCT				*	1.6	1.3	2.8	0.2		
361 LEAKING-INTERN/EXTER				*	1.6	1.3	1.9	0.2		
537 LOW POWER OR THRUST				*	2.1	1.7	4.9	0.4		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PER	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
REPAIR	OFF	O	19.2	2.3	12.8	10.2	245.0	21.2	3	2
REPLACE	ON	O	42.2	2.4	35.6	28.3	1501.5	129.8	1	1
301 FOREIGN OBJCT DAMAGE				*	3.6	2.8	163.7	14.1		
317 HOT START				*	3.7	3.0	135.1	11.7		
804 NO-DEF/SCHED MAINT				*	4.7	3.7	231.2	20.0		
OTHER			0.0		45.6	36.3	0.0	0.0		
COMPONENT TOTAL			14.5	2.3	125.6	100.0	1818.0	100.0		
22261 FUEL REGULATOR										
REPAIR	ON	O	1.5	1.5	20.4	62.4	31.5	36.9	1	2
127 ADJUST/ALIGN IMPROPER				*	13.1	40.1	11.3	13.2		
537 LOW POWER OR THRUST				*	2.6	7.9	2.3	2.7		
INSTALL	ON	O	7.2	1.5	0.6	2.0	4.7	5.5	3	3
REPLACE	ON	O	7.8	1.7	5.3	16.3	41.6	48.8	2	1
242 NO OPER,REAS UNKNOWN				*	1.3	4.0	13.7	16.0		
381 LEAKING-INTERN/EXTER				*	1.0	3.0	9.7	11.4		
OTHER			1.2	1.6	6.3	19.3	7.6	8.9		
COMPONENT TOTAL			2.6	1.6	32.7	100.0	85.4	100.0		
22262 MAIN FUEL MANIFOLD										
REPAIR	ON	O	3.0	1.5	4.2	59.0	12.4	34.7	1	2
127 ADJUST/ALIGN IMPROPER				*	0.3	4.5	0.2	0.5		
381 LEAKING-INTERN/EXTER				*	1.9	27.3	7.5	20.9		
730 LOOSE				*	0.6	9.1	0.4	1.2		
REPAIR	OFF	O	17.2	2.0	0.2	2.2	2.8	7.7	3	3
REPLACE	ON	O	5.5	2.1	2.4	34.1	13.4	37.3	2	1
381 LEAKING-INTERN/EXTER				*	1.9	27.3	9.9	27.6		
OTHER			22.0	2.0	0.3	4.6	7.3	20.3		
COMPONENT TOTAL			5.0	1.8	7.1	100.0	35.8	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PER	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
22263 START FUEL SOL VALVE										
REPAIR	ON	C	1.2	1.0	3.4	46.7	4.0	51.1	1	1
135 BINDING/STUCK/JAMMED				*	0.6	8.	0.8	10.9		
374 INTERNAL FAILURE				*	0.8	11.1	1.1	14.7		
381 LEAKING-INTERN/EXTER				*	0.5	6.7	0.4	4.6		
450 OPEN				*	0.5	6.7	1.4	12.5		
901 INTERMITTENT				*	0.3	4.4	0.2	2.1		
REMOVE	ON	O	0.6	1.1	1.1	15.5	0.7	9.0	2	3
799 NO DEFECT				*	1.1	15.5	0.7	9.0		
INSTALL	ON	O	0.5	1.0	1.1	15.5	0.6	7.9	3	4
799 NO DEFECT				*	1.1	15.5	0.6	7.9		
REPLACE	ON	O	2.5	2.4	0.6	8.9	1.6	21.0	4	2
242 NO OPER,REAS UNKNOWN				*	0.5	6.7	1.5	19.3		
OTHER			0.9	1.7	1.0	13.3	0.8	11.0		
COMPONENT TOTAL			1.1	1.5	7.3	100.0	7.8	100.0		
2226310 STARTING FUEL NOZZLE										
REPAIR	ON	C	4.8	1.4	0.5	18.9	2.3	29.1	2	2
109 UNIDENTIFIED BY CODE				*	0.2	6.3	0.1	1.0		
177 FUEL FLOW INCORRECT				*	0.3	12.6	2.3	28.1		
REPLACE	ON	O	4.4	1.7	1.5	56.4	6.4	79.9	1	1
070 BROKEN				*	0.2	6.3	0.2	2.3		
177 FUEL FLOW INCORRECT				*	0.2	6.3	1.5	18.3		
190 CRACKED				*	0.2	6.3	0.1	1.1		
230 DIRTY				*	0.3	12.5	0.7	9.1		
242 NO OPER,REAS UNKNOWN				*	0.2	6.3	2.2	27.4		
277 FUEL NOZZLE COKING				*	0.3	12.5	0.7	9.1		
314 SLOW ACCELERATION				*	0.2	6.3	1.0	12.5		
OTHER			0.0		0.5	24.7	0.0	0.0		
COMPONENT TOTAL			3.4	1.6	2.6	100.0	8.8	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
22291 EXCITER UNIT										
CHECK	ON	O	9.2	3.4	0.5	6.3	4.5	26.9	4	1
REPAIR	ON	O	1.7	1.6	2.1	27.1	3.5	20.7	1	3
374 INTERNAL FAILURE				*	1.0	12.5	1.6	9.6		
958 INCORRECT DISPLAY				*	0.3	4.2	0.5	2.9		
INSTALL	ON	O	0.8	1.0	1.1	14.6	0.9	5.3	3	4
799 NO DEFECT				*	1.1	14.6	0.9	5.3		
REPLACE	ON	O	1.9	1.4	2.1	27.1	4.0	23.7	2	2
070 BROKEN				*	0.3	4.2	0.2	1.3		
242 NO OPER,REAS UNKNOWN				*	0.5	6.3	0.5	3.2		
255 NO OUTPUT				*	0.3	4.2	0.2	1.0		
374 INTERNAL FAILURE				*	0.5	6.3	0.8	4.7		
OTHER			2.0	1.3	1.9	25.0	4.0	23.5		
COMPONENT TOTAL			2.2	1.6	7.8	100.0	16.8	100.0		
22293 IGNITER PLUG										
REPAIR	ON	O	3.7	2.3	2.3	49.9	6.3	46.8	1	1
020 WORN,CHAFED,FRAYED				*	0.2	3.5	1.9	10.9		
106 MISSING HARDWARE				*	0.2	3.5	0.0	0.3		
108 BROKEN SFTY WIRE/KEY				*	0.2	3.5	0.5	2.7		
127 ADJST/ALIGN IMPROPER				*	0.2	3.5	0.1	0.5		
190 CRACKED				*	0.3	7.1	4.1	23.0		
230 DIRTY				*	0.2	3.5	0.1	0.5		
242 NO OPER,REAS UNKNOWN				*	0.3	7.1	0.6	3.6		
255 NO OUTPUT				*	0.2	3.5	0.1	0.5		
602 FAIL DUE ASSOC EQUIP				*	0.2	3.5	0.1	0.5		
615 SHORTED				*	0.2	3.5	0.0	0.3		
730 LOOSE				*	0.2	3.5	0.4	2.3		
900 BURNED OR OVERHEATED				*	0.2	3.5	0.3	1.8		
REPLACE	ON	O	1.8	1.4	1.8	39.3	3.2	18.0	2	2
070 BROKEN				*	0.2	3.6	0.1	0.7		
117 DETERIORATED				*	0.2	3.6	0.2	1.0		
242 NO OPER,REAS UNKNOWN				*	0.5	10.7	1.3	7.1		
255 NO OUTPUT				*	0.2	3.6	0.3	1.7		
314 SLOW ACCELERATION				*	0.2	3.6	0.4	2.4		
317 HOT START				*	0.2	3.6	0.2	1.2		
334 TEMPERATURE INCORRCT				*	0.2	3.6	0.2	1.2		
900 BURNED OR OVERHEATED				*	0.3	7.2	0.5	2.7		
OTHER			12.7	1.4	0.5	10.8	6.2	35.3		
COMPONENT TOTAL			3.9	1.7	4.5	100.0	17.7	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	LEV	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
26111 MAIN DRIVE SHAFT ASSY										
REPAIR	ON	O	3.2	1.9	5.5	8.2	17.8	8.5	3	3
REPAIR	OFF	O	3.7	1.3	11.5	17.1	42.5	20.4	2	2
381 LEAKING-INTERN/EXTER				*	4.2	6.3	15.4	7.4		
410 LACK OF/IMPROP LUBE				*	1.8	2.7	3.9	1.9		
804 NO-DEF/SCHED MAINT				*	1.8	2.7	6.2	3.0		
REPLACE	ON	O	3.5	1.5	28.5	42.4	99.6	47.7	1	1
020 WORN,CHAFED,FRAYED				*	11.0	16.4	36.6	17.5		
381 LEAKING-INTERN/EXTER				*	4.2	6.3	9.9	4.7		
800 NO-DEF/OTHER MAINT				*	2.1	3.1	4.9	2.3		
804 NO-DEF/SCHED MAINT				*	3.1	4.6	20.6	9.9		
OTHER			2.2	1.4	21.7	32.3	48.7	23.3		
COMPONENT TOTAL			3.1	1.5	67.1	100.0	208.7	100.0		
26211 MAIN TRANS ASSY										
REPLACE	ON	O	31.4	2.3	8.6	35.6	269.1	107.8	1	1
020 WORN,CHAFED,FRAYED				*	0.8	3.3	18.8	7.5		
381 LEAKING-INTERN/EXTER				*	1.0	4.0	38.8	15.5		
800 NO-DEF/OTHER MAINT				*	0.6	2.7	16.1	6.5		
803 NO-DEF/TIME CHANGE				*	3.1	12.7	137.8	55.2		
OTHER			0.0	0.0	15.5	64.4	0.0	0.0		
COMPONENT TOTAL			11.2	2.8	24.1	100.0	269.1	100.0		
26210 MAST ASSY										
REPAIR	ON	O	1.4	1.4	6.9	27.7	9.8	5.8	2	2
020 WORN,CHAFED,FRAYED				*	1.0	3.9	2.1	1.2		
167 TORQUE INCORRECT				*	0.6	2.6	0.4	0.2		
170 CORRODED				*	1.1	4.5	0.8	0.5		
730 LOOSE				*	1.6	6.5	3.6	2.2		
INSTALL	ON	O	8.9	1.7	1.0	3.9	8.7	5.1	3	3
799 NO DEFECT				*	1.0	3.9	8.7	5.1		
REPLACE	ON	O	10.3	2.4	10.7	42.6	109.9	65.0	1	1
020 WORN,CHAFED,FRAYED				*	2.6	10.3	11.8	7.0		
381 LEAKING-INTERN/EXTER				*	1.0	3.9	12.6	7.5		
803 NO-DEF/TIME CHANGE				*	3.6	14.2	53.1	31.4		
OTHER			6.3	2.6	6.5	25.8	40.8	24.1		
COMPONENT TOTAL			5.7	2.3	25.1	100.0	169.2	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
2621E MAIN INPUT QUILL ASSY										
REPAIR	ON	D	5.0	1.7	8.1	28.7	40.6	32.0	2	2
020 WORN,CHAFED,FRAYED				*	0.8	2.9	2.6	2.1		
381 LEAKING-INTERN/EXTER				*	6.0	21.3	33.5	26.4		
REPLACE	ON	D	7.3	1.5	11.0	39.1	80.3	63.3	1	1
381 LEAKING-INTERN/EXTER				*	9.5	33.9	74.0	58.4		
OTHER			0.6	2.3	9.0	32.2	5.9	4.6		
COMPONENT TOTAL			4.5	1.6	28.1	100.0	126.8	100.0		
2621J TUBING										
REPAIR	ON	O	1.0	1.0	2.4	48.5	2.5	51.0	1	1
070 BROKEN				*	0.2	3.2	0.2	3.3		
127 ADJST/ALIGN IMPROPER				*	0.2	3.2	0.1	1.6		
381 LEAKING-INTERN/EXTER				*	1.5	29.1	1.8	37.1		
730 LOOSE				*	0.3	6.5	0.2	4.9		
780 BENT,BUCKLED,ETC				*	0.3	6.5	0.2	4.0		
REMOVE	ON	O	0.7	1.0	0.6	13.0	0.4	9.2	3	3
799 NO DEFECT				*	0.6	13.0	0.4	9.2		
INSTALL	ON	O	0.7	1.0	0.5	9.8	0.3	6.6	4	4
093 MISSING PART				*	0.2	3.3	0.2	3.3		
799 NO DEFECT				*	0.3	6.5	0.2	3.3		
REPLACE	ON	O	1.3	1.0	1.1	22.6	1.5	30.1	2	2
020 WORN,CHAFED,FRAYED				*	0.5	9.7	0.6	11.7		
190 CRACKED				*	0.2	3.2	0.5	10.0		
381 LEAKING-INTERN/EXTER				*	0.2	3.2	0.2	3.3		
720 BRUSH FAILING/WORN				*	0.2	3.2	0.2	3.3		
780 BENT,BUCKLED,ETC				*	0.2	3.2	0.1	1.7		
OTHER			0.5	0.9	0.3	6.2	0.1	3.1		
COMPONENT TOTAL			1.0	1.0	5.0	100.0	4.9	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
2621K HOSE										
REPAIR	ON	C	1.2	1.1	2.4	45.5	2.6	42.7	1	1
020 WORN,CHAFED,FRAYED				*	0.3	6.1	0.4	6.1		
106 MISSING HARDWARE				*	0.5	9.1	0.8	11.7		
127 ADJST/ALIGN IMPROPER				*	0.6	12.1	0.7	10.2		
381 LEAKING-INTERN/EXTER				*	0.6	12.1	0.6	8.5		
437 IMPROP POSTND/SLCTD				*	0.2	3.0	0.3	4.9		
730 LOOSE				*	0.2	3.0	0.1	1.2		
REMOVE	ON	O	0.6	1.0	0.6	12.2	0.4	5.9	4	4
799 NO DEFECT				*	0.6	12.2	0.4	5.9		
INSTALL	ON	C	0.6	1.0	0.8	15.2	0.5	7.4	3	3
799 NO DEFECT				*	0.8	15.2	0.5	7.4		
REPLACE	ON	C	1.7	1.4	1.5	27.3	2.5	37.4	2	2
020 WORN,CHAFED,FRAYED				*	1.0	18.2	2.1	32.1		
070 BROKEN				*	0.3	6.1	0.3	4.3		
780 BENT,BUCKLED,ETC				*	0.2	3.0	0.1	1.0		
OTHER			1.7	1.4	0.0	0.0	0.4	6.6		
COMPONENT TOTAL			1.2	1.2	5.3	100.0	6.6	100.0		
26411 TAIL DRIVE SHAFT ASSY										
REPAIR	ON	O	1.5	1.3	6.3	33.9	9.8	32.9	2	2
020 WORN,CHAFED,FRAYED				*	2.6	13.9	4.3	14.4		
127 ADJST/ALIGN IMPROPER				*	0.5	2.6	0.4	1.3		
780 BENT,BUCKLED,ETC				*	1.3	7.0	1.0	3.4		
REPLACE	ON	C	1.7	1.3	9.4	50.4	15.9	53.6	1	1
020 WORN,CHAFED,FRAYED				*	2.3	12.2	4.6	15.6		
731 BATTLE DAMAGE				*	0.6	3.5	1.0	3.3		
780 BENT,BUCKLED,ETC				*	1.0	5.0	1.6	5.4		
800 NO-DEF/OTHER MAINT				*	0.8	4.3	1.0	3.4		
935 SCORED OR SCRATCHED				*	2.1	11.3	2.2	7.3		
OTHER			1.4	1.1	2.9	15.6	4.0	13.5		
COMPONENT TOTAL			1.6	1.3	18.6	100.0	29.7	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
26413 HANGER ASSY										
REPAIR	ON	C	2.6	1.2	7.6	13.9	20.1	17.0	3	3
020 WORN,CHAFED,FRAYED				*	1.8	3.2	3.3	2.8		
REPAIR	OFF	G	2.5	1.2	11.0	20.1	27.2	23.0	2	2
020 WORN,CHAFED,FRAYED				*	1.5	2.6	3.1	2.6		
710 BRG FAILING/FAULTY				*	8.3	15.0	20.0	16.9		
REPLACE	ON	C	2.0	1.3	29.4	53.7	58.9	49.7	1	1
020 WORN,CHAFED,FRAYED				*	16.8	30.7	29.9	25.3		
381 LEAKING-INTERN/EXTER				*	2.3	4.1	3.9	3.3		
710 BRG FAILING/FAULTY				*	6.6	12.1	13.3	11.2		
OTHER			1.8	1.0	6.9	12.4	12.3	10.3		
COMPONENT TOTAL			2.2	1.2	54.8	100.0	118.4	100.0		
26414 INT. GEAR BOX										
REPAIR	ON	C	1.0	1.2	13.6	30.5	13.5	16.8	2	2
070 BROKEN				*	1.9	4.4	1.5	1.8		
230 DIRTY				*	2.4	5.5	3.0	3.6		
381 LEAKING-INTERN/EXTER				*	2.3	5.1	2.3	2.9		
REPLACE	ON	G	3.1	1.5	16.2	36.4	50.1	62.3	1	1
020 WORN,CHAFED,FRAYED				*	2.4	5.5	7.1	8.8		
381 LEAKING-INTERN/EXTER				*	4.2	9.5	12.1	15.1		
803 NO-DEF/TIME CHANGE				*	2.4	5.5	10.5	13.0		
OTHER			1.1	1.9	14.7	33.1	16.8	20.9		
COMPONENT TOTAL			1.8	1.5	44.5	100.0	80.4	100.0		
26415 TAIL GEAR BOX										
REPAIR	ON	C	1.6	1.3	34.1	37.7	54.7	23.6	[illegible]	[illegible]
020 WORN,CHAFED,FRAYED				*	2.4	2.7	3.3	1.4		
070 BROKEN				*	3.7	4.1	3.2	1.4		
230 DIRTY				*	3.4	3.8	13.5	5.5		
306 CONTAMINATION				*	4.0	4.8	6.8	2.9		
381 LEAKING-INTERN/EXTER				*	2.9	3.2	3.1	1.3		
INSTALL	ON	C	2.7	1.4	5.8	6.4	15.6	6.7	3	3
799 NO DEFECT				*	5.5	6.1	15.3	6.6		
REPLACE	ON	C	4.9	1.7	24.4	27.0	119.7	51.6	2	1
020 WORN,CHAFED,FRAYED				*	2.3	2.5	9.2	4.0		
306 CONTAMINATION				*	2.9	3.2	14.6	6.3		
381 LEAKING-INTERN/EXTER				*	4.9	5.[illegible]	28.8	12.4		
803 NO-DEF/TIME CHANGE				*	2.9	3.2	11.8	5.1		
916 IMPEND FAIL/OIL ANAL				*	3.9	4.3	23.6	10.2		
OTHER			1.5	1.6	26.2	24.9	42.0	18.1		
COMPONENT TOTAL			2.6	1.5	93.6	100.0	231.9	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
29132 PILLOW BLK ASSY										
REPAIR	ON	D	1.3	1.2	2.1	68.4	2.7	64.9	1	1
020 WORN,CHAFED,FRAYED				*	1.3	42.1	1.2	29.1		
710 BRG FAILING/FAULTY				*	0.3	10.5	1.2	28.0		
730 LOOSE				*	0.5	15.8	0.3	7.8		
REPLACE	ON	D	1.3	1.0	0.8	26.4	1.0	25.2	2	2
020 WORN,CHAFED,FRAYED				*	0.8	26.4	1.0	25.2		
OTHER			2.6	1.2	0.2	5.2	0.4	9.9		
COMPONENT TOTAL			1.4	1.1	3.1	100.0	4.2	100.0		
2923E PARTICLE SEPARATOR										
REPAIR	ON	C	1.8	1.1	4.7	76.3	8.4	85.9	1	1
070 BROKEN				*	0.8	13.1	2.9	29.8		
106 MISSING HARDWARE				*	0.5	7.9	0.3	4.6		
190 CRACKED				*	0.8	13.1	1.0	9.9		
230 DIRTY				*	0.8	13.1	0.6	5.8		
540 PUNCTURED				*	0.3	5.3	0.5	4.9		
780 BENT,BUCKLED,ETC				*	0.3	5.3	0.4	4.1		
REPLACE	ON	C	1.8	1.0	0.8	13.2	1.5	14.9	2	2
117 DETERIORATED				*	0.3	5.3	0.7	7.4		
540 PUNCTURED				*	0.2	2.6	0.2	2.5		
947 TORN				*	0.3	5.3	0.5	5.0		
OTHER			0.0		0.6	10.6	0.0	0.0		
COMPONENT TOTAL			1.6	1.1	6.1	100.0	9.9	100.0		
2931J DROOP COMP CAM BOX										
REPAIR	ON	O	1.3	1.2	18.9	73.6	24.2	54.2	1	1
020 WORN,CHAFED,FRAYED				*	1.1	4.4	1.7	3.7		
127 ADJUST/ALIGN IMPROPER				*	13.9	54.1	19.7	44.0		
315 RPM FLUCTUATION				*	1.5	5.7	1.2	2.6		
REPLACE	ON	O	2.4	1.4	3.1	11.9	7.4	16.5	2	2
020 WORN,CHAFED,FRAYED				*	1.0	3.8	2.4	5.3		
OTHER			3.5	1.2	3.7	14.5	13.1	29.3		
COMPONENT TOTAL			1.7	1.2	25.7	100.0	44.7	100.0		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
2931J10 LINEAR ACTUATOR										
CHECK	ON	C	1.6	1.6	3.4	5.6	5.5	6.0	4	4
799 NO DEFECT				*	3.1	5.1	2.5	2.7		
REPAIR	ON	O	1.1	1.3	26.2	43.3	28.0	30.3	1	2
070 BROKEN				*	1.8	2.9	1.8	2.0		
127 ADJST/ALIGN IMPROPER				*	13.1	21.7	14.7	15.9		
REPAIR	OFF	D	2.0	1.3	6.5	10.7	12.7	13.7	3	3
453 OPEN				*	1.6	2.7	3.4	3.7		
REPLACE	ON	O	2.1	1.2	14.7	24.3	30.9	33.5	2	1
135 BINDING/STUCK/JAMMED				*	2.6	4.3	5.3	5.8		
242 NO OPER,REAS UNKNOWN				*	5.5	9.1	11.4	12.4		
OTHER			1.6	1.1	9.7	16.0	15.1	16.4		
COMPONENT TOTAL			1.5	1.2	60.5	100.0	92.2	100.0		
29321 RPM WARN LMT DET/BOX										
REPAIR	ON	C	1.5	1.4	32.3	19.1	47.4	13.9	3	3
127 ADJST/ALIGN IMPROPER				*	22.6	13.4	26.2	7.7		
REPAIR	OFF	D	1.8	1.2	55.8	33.0	100.0	29.3	2	2
127 ADJST/ALIGN IMPROPER				*	33.5	19.8	43.0	12.6		
615 SHORTED				*	10.4	6.1	20.0	5.9		
REPLACE	ON	O	2.4	1.8	58.5	34.6	140.5	41.1	1	1
374 INTERNAL FAILURE				*	30.1	17.8	66.7	19.5		
901 INTERMITTENT				*	12.5	7.4	39.8	11.6		
958 INCORRECT DISPLAY				*	6.1	3.6	11.1	3.2		
OTHER			2.4	1.2	22.5	13.3	53.8	15.8		
COMPONENT TOTAL			2.0	1.4	169.1	100.0	341.8	100.0		
29421 OIL TANK										
REPAIR	ON	O	1.1	1.2	4.8	60.0	5.2	47.3	1	1
070 BROKEN				*	0.5	6.0	0.6	5.2		
106 MISSING HARDWARE				*	0.3	4.0	0.2	1.5		
190 CRACKED				*	0.3	4.0	0.2	2.2		
381 LEAKING-INTERN/EXTER				*	2.1	26.0	3.0	27.5		
410 LACK OF/IMPROP LUBE				*	0.3	4.0	0.1	0.9		
730 LOOSE				*	0.3	4.3	0.2	2.2		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PER	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
REMOVE	ON	C	2.5	1.4	0.5	6.1	1.2	11.1	3	3
799 NO DEFECT				*	0.3	4.0	0.6	5.2		
REPLACE	ON	C	2.1	1.2	1.6	20.0	3.4	31.1	2	2
020 WORN,CHAFED,FRAYED				*	0.3	4.0	0.4	3.8		
070 BROKEN				*	0.3	4.0	0.5	5.0		
127 ADJST/ALIGN IMPROPER				*	0.2	2.0	1.5	13.4		
381 LEAKING-INTERN/EXTER				*	0.3	4.0	0.5	4.5		
800 NO-DEF/OTHER MAINT				*	0.3	4.0	0.2	2.2		
OTHER			1.0	1.4	1.1	14.0	1.1	10.4		
COMPONENT TOTAL			1.3	1.2	8.1	100.0	10.9	100.0		
29422 OIL COOLER										
REPAIR	ON	C	1.6	1.4	4.2	37.6	6.8	23.2	1	2
020 WORN,CHAFED,FRAYED				*	0.6	5.8	1.5	5.1		
070 BROKEN				*	0.6	5.8	0.4	1.3		
190 CRACKED				*	0.3	2.9	0.5	1.7		
381 LEAKING-INTERN/EXTER				*	1.1	10.1	1.3	4.4		
INSTALL	ON	C	2.6	1.0	0.6	5.8	1.7	5.8	3	3
093 MISSING PART				*	0.2	1.5	0.1	0.4		
799 NO DEFECT				*	0.5	4.4	1.6	5.3		
REPLACE	ON	C	3.1	1.3	3.2	28.9	10.0	34.0	2	1
020 WORN,CHAFED,FRAYED				*	0.6	5.8	1.1	3.9		
070 BROKEN				*	0.3	2.9	0.3	0.9		
306 CONTAMINATION				*	0.5	4.3	3.9	13.3		
710 BRG FAILING/FAULTY				*	0.5	4.3	1.0	3.5		
800 NO-DEF/OTHER MAINT				*	0.3	2.9	1.5	5.1		
OTHER			3.5	1.3	3.1	27.6	10.9	37.0		
COMPONENT TOTAL			2.6	1.2	11.2	100.0	29.4	100.0		
29621 TAIL PIPE										
REPAIR	ON	O	1.0	1.7	0.8	26.4	0.8	19.2	2	3
127 ADJST/ALIGN IMPROPER				*	0.2	5.3	0.3	7.8		
190 CRACKED				*	0.5	15.9	0.4	10.2		
799 NO DEFECT				*	0.2	5.3	0.0	1.2		
REPAIR	OFF	O	3.1	1.6	0.3	10.4	1.0	24.1	3	2
190 CRACKED				*	0.3	10.4	1.0	24.1		

TABLE XXXVI - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
REPLACE	ON	0	3.1	1.6	1.1	36.8	3.5	85.2	1	1
190 CRACKED				*	0.6	21.0	2.3	56.8		
731 BATTLE DAMAGE				*	0.2	5.3	0.3	7.1		
780 BENT,BUCKLED,ETC				*	0.2	5.3	0.3	7.1		
932 LOCKS/UNLOCKS INCORR				*	0.2	5.3	0.6	14.2		
OTHER			0.0		0.8	26.4	0.0	0.0		
COMPONENT TOTAL			1.7	1.6	3.1	100.0	5.3	100.0		
42111 AC GENERATOR										
CHECK	ON	0	3.2	2.4	5.2	12.1	16.5	12.0	3	3
799 NO DEFECT				*	4.7	10.9	3.4	2.5		
REPAIR	ON	0	2.1	1.7	8.3	19.3	17.3	12.6	2	2
070 BROKEN				*	2.3	5.3	4.3	3.1		
REMOVE	ON	0	1.9	1.4	4.7	10.9	8.7	6.3	5	5
799 NO DEFECT				*	4.7	10.9	8.7	6.3		
INSTALL	ON	0	2.4	1.4	5.2	12.1	12.6	9.2	4	4
799 NO DEFECT				*	5.2	12.1	12.6	9.2		
REPLACE	ON	0	2.7	1.7	11.6	27.2	31.4	22.8	1	1
169 INCORRECT VOLTAGE				*	1.3	3.0	5.5	4.0		
374 INTERNAL FAILURE				*	4.4	10.2	10.3	7.5		
800 NO-DEF/OTHER MAINT				*	1.6	3.8	6.8	4.9		
OTHER			6.4	2.1	7.9	18.5	51.0	37.1		
COMPONENT TOTAL			3.2	1.8	42.6	100.0	137.7	100.0		
42211 STARTER GENERATOR										
CHECK	ON	0	3.4	1.5	3.7	13.1	12.6	13.8	3	3
799 NO DEFECT				*	2.9	10.3	4.2	4.6		
REPAIR	ON	0	2.0	1.8	7.6	26.9	15.2	16.7	2	2
070 BROKEN				*	0.8	2.8	0.7	0.[illegible]		
730 LOOSE				*	1.1	4.0	1.1	1.[illegible]		
REPLACE	ON	0	3.2	1.5	8.1	28.6	25.9	28.4	1	1
374 INTERNAL FAILURE				*	3.7	13.1	13.0	14.3		
800 NO-DEF/OTHER MAINT				*	1.1	4.0	2.6	2.9		
OTHER			4.2	1.4	8.9	31.4	37.4	41.1		
COMPONENT TOTAL			3.2	1.5	28.3	100.0	91.0	100.0		

TABLE XXXVII. COMPONENT MAINTENANCE REQUIREMENTS, AH-1 HELICOPTER

ACTION REASON/FAILURE MODE	ON/ OFF A/C	I & V	MH/ MA AVG	AVG AC PER	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
14118 COLLECTIVE PITCH ASSY										
REPAIR	ON	0	1.4	1.2	2.9	31.8	4.2	53.2	1	1
020 WORN, CHAFED, FRAYED				*	0.5	9.1	0.8	10.6		
127 ADJST/ALIGN IMPROPER				*	0.8	9.1	1.9	24.0		
503 SUDDEN STOP				*	0.4	4.5	0.4	5.3		
660 STRIPPED				*	0.8	9.1	1.0	13.3		
REPLACE	ON	0	1.6	1.0	2.5	27.3	4.0	51.2	2	2
020 WORN, CHAFED, FRAYED				*	0.8	9.1	0.8	10.2		
464 OVERSPEED				*	0.4	4.6	0.8	10.2		
503 SUDDEN STOP				*	0.4	4.6	0.8	10.2		
720 BRUSH FAILING/WORN				*	0.8	9.1	1.6	20.5		
OTHER			0.0		3.8	40.9	0.0	0.0		
COMPONENT TOTAL			0.9	1.1	9.2	100.0	8.2	100.0		
14128 CYCLIC SWSH PLT/SUP ASSY										
REPAIR	ON	0	4.8	1.7	12.1	28.7	57.6	25.6	2	2
127 ADJST/ALIGN IMPROPER				*	3.8	8.9	22.4	9.9		
730 LOOSE				*	4.6	10.9	27.7	12.3		
INSTALL	ON	0	13.0	2.0	1.3	3.0	16.3	7.2	3	3
REPLACE	ON	0	7.5	2.4	17.1	40.6	128.4	57.1	1	1
020 WORN, CHAFED, FRAYED				*	5.8	13.8	39.4	17.5		
190 CRACKED				*	1.2	3.0	4.0	1.8		
503 SUDDEN STOP				*	2.5	5.9	17.6	7.8		
710 BRG FAILING/FAULTY				*	1.2	3.0	14.4	6.4		
803 NO-DEF//TIME CHANGE				*	1.2	3.0	7.6	3.4		
935 SCORED OR SCRATCHED				*	1.2	3.0	21.3	9.5		
OTHER			1.9	2.4	11.7	27.7	22.5	10.0		
COMPONENT TOTAL			5.3	2.1	42.2	100.0	224.9	100.0		

TABLE XXXVII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
14141 FLT CNTRL CYL/CONT VALVE										
CHECK	ON	O	2.0	2.0	20.9	16.0	41.6	7.2	3	3
799 NO DEFECT				*	20.9	16.0	41.6	7.2		
REPAIR	ON	O	3.5	2.0	33.0	25.3	114.4	19.9	2	2
127 ADJST/ALIGN IMPROPER				*	14.6	11.2	57.3	10.0		
381 LEAKING-INTERN/EXTER				*	4.2	3.2	20.0	3.5		
REPLACE	ON	O	3.2	2.1	40.9	31.4	130.9	22.8	1	1
135 BINDING/STUCK/JAMMED				*	3.4	2.6	17.4	3.0		
381 LEAKING-INTERN/EXTER				*	27.1	20.8	72.7	12.6		
602 FAIL DUE ASSOC EQUIP				*	3.8	2.9	5.4	0.9		
OTHER			8.1	1.9	35.5	27.2	288.5	50.1		
COMPONENT TOTAL			4.4	2.0	130.3	100.0	575.4	100.0		
15115 MAIN ROTOR HUB ASSY										
REPAIR	ON	O	1.5	1.6	25.0	25.3	36.6	7.8	2	3
127 ADJST/ALIGN IMPROPER				*	5.8	5.9	9.2	1.9		
190 CRACKED				*	3.3	3.4	2.0	0.4		
REPAIR	OFF	D	11.7	1.4	14.6	14.8	171.5	36.5	3	2
710 BRG FAILING/FAULTY				*	11.7	11.8	152.3	32.4		
REPLACE	ON	O	6.9	2.2	28.8	29.1	198.8	42.3	1	1
503 SUDDEN STOP				*	2.5	2.5	13.1	2.8		
561 UNABLE ADJ TO LIMITS				*	2.5	2.5	10.3	2.2		
710 BRG FAILING/FAULTY				*	2.9	2.9	20.1	4.3		
804 NO-DEF/SCHED MAINT				*	4.6	4.6	42.9	9.1		
OTHER			2.1	2.1	30.5	30.8	63.5	13.5		
COMPONENT TOTAL			4.8	1.8	99.0	100.0	470.5	100.0		
15211 TAIL ROTOR HUB ASSY										
CHECK	OFF	D	1.5	1.0	13.8	15.3	21.2	10.0	3	3
799 NO DEFECT				*	12.9	14.4	19.1	9.0		
804 NO-DEF/SCHED MAINT				*	0.8	0.9	2.1	1.0		
REPAIR	OFF	D	2.8	1.0	14.2	15.8	39.5	18.6	2	2
710 BRG FAILING/FAULTY				*	10.9	12.1	31.1	14.6		

TABLE XXXVII - Continued

ACTION REASON/FAILURE MODE	ON/OFF A/C	LEV	MH/MA AVG	AVG MEN	MA/FH RATE	MA/FH PCNT	MH/FH RATE	MH/FH PCNT	R-A-N-K MA/FH	R-A-N-K MH/FH
INSTALL	ON	O	7.9	1.7	2.5	2.6	19.9	9.4	4	4
799 NO DEFECT				*	2.5	2.6	19.9	9.4		
REPLACE	ON	O	3.6	1.2	40.5	45.1	145.8	68.7	1	1
135 BINDING/STUCK/JAMMED				*	2.9	3.2	7.0	3.3		
190 CRACKED				*	3.6	4.2	9.8	4.6		
710 BRG FAILING/FAULTY				*	3.8	4.2	12.8	6.0		
804 NO-DEF/SCHED MAINT				*	17.5	19.5	71.7	33.8		
OTHER			0.0		18.8	20.9	0.0	0.0		
COMPONENT TOTAL			2.5	1.2	89.8	100.0	226.3	100.0		
15212 TAIL ROTOR BLADE ASSY										
REPAIR	ON	O	0.9	1.2	4.6	15.5	4.2	7.2	2	3
127 ADJST/ALIGN IMPROPER				*	0.8	2.8	0.4	0.7		
INSTALL	ON	O	4.7	1.0	2.1	7.0	9.8	16.7	3	2
093 MISSING PART				*	0.8	2.8	4.2	7.1		
799 NO DEFECT				*	1.3	4.2	5.6	9.6		
REPLACE	ON	O	3.7	1.1	20.9	70.4	77.3	131.5	1	1
117 DETERIORATED				*	1.7	5.6	3.7	6.3		
127 ADJST/ALIGN IMPROPER				*	2.5	8.5	4.4	7.5		
503 SUDDEN STOP				*	3.3	11.3	8.7	14.9		
602 FAIL DUE ASSOC EQUIP				*	1.3	4.2	3.3	5.7		
731 BATTLE DAMAGE				*	1.3	4.2	10.7	18.3		
780 BENT,BUCKLED,ETC				*	3.3	11.3	15.5	26.4		
803 NO-DEF/TIME CHANGE				*	2.5	8.5	7.6	13.0		
OTHER			0.0		2.1	7.0	0.0	0.0		
COMPONENT TOTAL			3.1	1.1	29.6	100.0	91.3	100.0		

TABLE XXXVII -- Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
22200 T53 ENGINE										
REPAIR	ON	D	3.0	1.8	13.8	15.8	40.8	5.8	2	3
230 DIRTY				*	2.5	2.9	3.1	0.5		
REPAIR	OFF	D	15.3	2.1	4.2	4.8	64.1	9.2	3	2
REPLACE	ON	D	43.0	3.0	34.2	39.2	1472.3	211.1	1	1
381 LEAKING-INTERN/EXTER				*	3.4	3.8	197.3	28.3		
804 NO-DEF/SCHED MAINT				*	7.5	8.6	325.4	46.6		
OTHER			0.0		35.1	40.2	0.0	0.0		
COMPONENT TOTAL			16.1	2.9	87.3	100.0	1577.2	100.0		
22261 FUEL REGULATOR										
REPAIR	ON	O	0.9	1.2	12.5	73.2	11.4	40.3	1	2
127 ADJUST/ALIGN IMPROPER				*	11.3	65.9	8.9	31.5		
381 LEAKING-INTERN/EXTER				*	0.8	4.9	2.3	8.1		
REPLACE	ON	O	6.0	1.7	3.3	19.5	20.0	70.6	2	1
127 ADJUST/ALIGN IMPROPER				*	1.7	9.8	10.9	38.5		
OTHER			0.0		1.3	7.3	0.0	0.0		
COMPONENT TOTAL			1.8	1.5	17.1	100.0	31.5	100.0		
22277 OIL HOSE										
REPAIR	ON	O	0.4	1.0	5.0	54.5	2.2	45.2	1	2
020 WORN,CHAFED,FRAYED				*	1.7	18.2	0.7	14.5		
381 LEAKING-INTERN/EXTER				*	2.5	27.3	1.2	23.9		
437 IMPROP POSTND/SLCTD				*	0.4	4.5	0.1	2.6		
730 LOOSE				*	0.4	4.5	0.2	4.2		
REPLACE	ON	O	1.3	1.2	4.2	45.5	5.4	111.0	2	1
020 WORN,CHAFED,FRAYED				*	3.3	36.4	4.8	98.9		
381 LEAKING-INTERN/EXTER				*	0.4	4.5	0.2	3.4		
780 BENT,BUCKLED,ETC				*	0.4	4.5	0.4	8.7		
COMPONENT TOTAL			0.8	1.1	9.2	100.0	7.6	100.0		

TABLE XXXVII - Continued

ACTION REASON/FAILURE CODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PER	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
2621C MAST ASSY										
REPAIR	ON	0	1.8	1.3	8.8	28.4	15.7	13.4	2	2
020 WORN,CHAFED,FRAYED				*	2.5	8.1	6.5	5.4		
108 BROKEN SFTY WIRE/KEY				*	0.8	2.7	0.4	0.4		
167 TOROLE INCORRECT				*	1.7	5.4	4.3	3.7		
730 LOOSE				*	0.8	2.7	0.7	0.6		
935 SCORED OR SCRATCHED				*	1.7	5.4	1.7	1.4		
REPLACE	ON	0	8.3	2.2	12.9	41.9	107.4	92.2	1	1
020 WORN,CHAFED,FRAYED				*	1.7	5.4	4.7	4.1		
167 TORQUE INCORRECT				*	0.8	2.7	5.8	5.0		
503 SUDDEN STOP				*	2.9	9.5	27.2	23.3		
803 NO-DEF/TIME CHANGE				*	2.5	8.1	20.5	17.6		
935 SCORED OR SCRATCHED				*	2.5	8.1	31.5	27.0		
OTHER			5.0		9.2	29.7	0.0	0.0		
COMPONENT TOTAL			4.0	2.1	30.9	100.0	123.1	100.0		
2621E MAIN INPUT QUILL ASSY										
REPAIR	ON	0	3.8	2.0	4.2	15.4	15.7	15.8	2	2
381 LEAKING-INTERN/EXTER				*	4.2	15.4	15.7	15.8		
REPLACE	ON	0	6.4	1.7	13.4	49.2	85.5	84.1	1	1
381 LEAKING-INTERN,EXTER				*	11.7	43.1	77.3	77.3		
OTHER			0.0	0.0	9.6	35.4	0.0	0.0		
COMPONENT TOTAL			3.7	1.7	27.1	100.0	101.2	100.0		
2621J TUBING										
CHECK	ON	0	1.0	2.0	0.4	14.4	0.4	12.6	2	4
799 NO DEFECT				*	0.4	14.4	0.4	12.6		
REPAIR	ON	0	1.3	1.7	1.3	42.8	1.7	53.0	1	1
381 LEAKING-INTERN/EXTER				*	1.3	42.8	1.7	53.0		
REMOVE	ON	0	0.4	1.0	0.4	14.4	0.2	5.1	3	3
799 NO DEFECT				*	0.4	14.4	0.2	5.1		
INSTALL	ON	0	2.0	1.0	0.4	14.4	0.8	25.1	4	2
799 NO DEFECT				*	0.4	14.4	0.8	25.1		

TABLE XXXVII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
REPLACE	ON	O	1.1	1.0	0.4	14.4	0.5	13.8	5	3
020 WORN,CHAFED,FRAYED				*	0.4	14.4	0.5	13.8		
COMPONENT TOTAL			1.2	1.3	2.9	100.0	3.6	100.0		
2621K HOSE										
REPAIR	ON	O	0.6	1.0	1.7	50.0	1.0	45.2	1	2
020 WORN,CHAFED,FRAYED				*	0.4	12.5	0.4	18.1		
381 LEAKING-INTERN/EXTER				*	0.8	25.0	0.3	12.7		
719 BROKEN GROUND WIRE				*	0.4	12.5	0.3	14.5		
REPLACE	ON	O	1.4	1.1	1.7	50.0	2.3	101.7	2	1
020 WORN,CHAFED,FRAYED				*	1.3	37.5	1.9	84.7		
381 LEAKING-INTERN/EXTER				*	0.4	12.5	0.4	17.0		
COMPONENT TOTAL			1.0	1.1	3.3	100.0	3.4	100.0		
26111 MAIN DRIVE SHAFT ASSY										
REPAIR	OFF	O	3.3	1.0	14.6	27.3	48.9	36.4	2	2
381 LEAKING-INTERN/EXTER				*	13.4	25.0	46.4	44.0		
REPLACE	ON	O	3.4	1.2	24.2	45.3	82.5	78.2	1	1
020 WORN,CHAFED,FRAYED				*	3.8	7.0	14.5	13.8		
381 LEAKING-INTERN/EXTER				*	10.0	18.8	35.1	33.3		
503 SUDDEN STOP				*	2.5	4.7	6.5	6.2		
804 NO-DEF/SCHED MAINT				*	2.1	3.9	9.3	8.8		
OTHER			0.0		14.6	27.4	0.0	0.0		
COMPONENT TOTAL			2.5	1.1	53.4	100.0	131.2	100.0		
26211 MAIN TRANS ASSY										
INSTALL	ON	O	79.5	2.0	0.4	1.9	33.4	13.3	2	2
REPLACE	ON	O	27.2	2.9	9.2	40.8	250.0	99.9	1	1
167 TORQUE INCORRECT				*	1.2	5.5	43.2	17.3		
190 CRACKED				*	0.8	3.7	18.5	7.4		
503 SUDDEN STOP				*	1.7	7.4	50.7	20.3		
803 NO-DEF/TIME CHANGE				*	2.9	13.0	63.0	25.2		
OTHER			0.0		12.9	57.4	0.0	0.0		
COMPONENT TOTAL			12.6	2.6	22.5	100.0	283.4	100.0		

TABLE XXXVII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
26411 TAIL DRIVE SHAFT ASSY										
REPAIR	ON	O	1.0	1.1	11.3	30.0	11.4	31.3	2	2
780 BENT,BUCKLED,ETC				*	2.1	5.5	3.2	8.9		
935 SCORED OR SCRATCHED				*	4.6	12.2	4.0	10.9		
REPLACE	ON	O	1.6	1.2	23.4	62.2	37.4	103.2	1	1
020 WORN,CHAFED,FRAYED				*	1.3	3.4	3.8	10.5		
503 SUDDEN STOP				*	6.3	16.7	5.3	14.8		
780 BENT,BUCKLED,ETC				*	2.9	7.8	4.9	13.6		
935 SCORED OR SCRATCHED				*	10.4	27.7	16.4	45.2		
OTHER			0.0		2.9	7.8	0.0	0.0		
COMPONENT TOTAL			1.3	1.2	37.6	100.0	48.8	100.0		
26413 HANGER ASSY										
REPAIR	OFF	O	1.8	1.1	32.1	18.8	59.5	35.9	2	2
710 BRG FAILING/FAULTY				*	30.1	17.6	57.6	34.8		
REPLACE	ON	O	1.9	1.1	113.2	66.3	215.0	129.8	1	1
020 WORN,CHAFED,FRAYED				*	59.7	35.0	98.9	59.7		
381 LEAKING-INTERN/EXTER				*	13.8	8.1	53.1	32.1		
503 SUDDEN STOP				*	7.1	4.2	7.3	4.4		
710 BRG FAILING/FAULTY				*	18.3	10.7	29.9	18.0		
OTHER			0.0		25.5	14.9	0.0	0.0		
COMPONENT TOTAL			1.6	1.1	170.8	100.0	274.5	100.0		
26414 INT GEARBOX										
REPAIR	ON	O	0.8	1.0	11.3	18.6	8.6	12.4	2	2
070 BROKEN				*	2.1	3.4	1.2	1.7		
306 CONTAMINATION				*	2.1	3.4	2.3	3.3		
381 LEAKING-INTERN/EXTER				*	1.7	2.8	0.6	0.9		
916 IMPEND FAIL/OIL ANYL				*	1.7	2.8	1.5	2.2		
INSTALL	ON	O	1.5	1.0	3.3	5.5	5.0	7.1	3	3
799 NO DEFECT				*	2.5	4.1	2.7	3.8		
REPLACE	ON	O	2.6	1.3	23.4	38.6	60.8	87.2	1	1
020 WORN,CHAFED,FRAYED				*	7.5	12.4	16.8	24.1		
167 TORQUE INCORRECT				*	1.7	2.7	5.5	7.8		
381 LEAKING-INTERN/EXTER				*	8.3	13.8	24.8	35.6		
503 SUDDEN STOP				*	2.1	3.4	3.4	4.9		
OTHER			0.0		22.6	37.3	0.0	0.0		
COMPONENT TOTAL			1.2	1.2	60.5	100.0	74.4	100.0		

TABLE XXXVII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
[illegible]6415 TAIL GEARBOX										
REPAIR	ON	O	0.8	1.1	15.9	25.2	12.9	8.9	2	2
230 DIRTY				*	4.6	7.3	2.9	2.0		
372 METAL ON MAGNET PLUG				*	1.7	2.6	1.7	1.2		
381 LEAKING-INTERN/EXTER				*	1.7	2.6	1.1	0.8		
916 IMPEND FAIL/OIL ANYL				*	4.2	6.6	4.3	3.0		
INSTALL	ON	O	6.3	1.7	1.7	2.6	10.5	7.2	3	3
799 NO DEFECT				*	1.3	2.0	2.1	1.5		
REPLACE	ON	O	4.8	1.6	27.1	43.0	130.3	90.0	1	1
020 WORN,CHAFED,FRAYED				*	5.0	8.0	24.4	16.8		
381 LEAKING-INTERN/EXTER				*	5.4	8.6	20.6	14.2		
503 SUDDEN STOP				*	2.5	4.0	6.0	4.1		
800 NO-DEF/OTHER MAINT				*	2.5	4.0	5.5	3.8		
916 IMPEND FAIL/OIL ANYL				*	3.3	5.3	25.0	17.3		
OTHER			0.0		18.4	29.1	0.0	0.0		
COMPONENT TOTAL			2.4	1.5	63.0	100.0	153.6	100.0		
29132 PILLOW BLK ASSY										
REPAIR	ON	D	0.9	1.0	1.3	33.2	1.1	32.2	2	2
020 WORN,CHAFED,FRAYED				*	0.4	11.1	0.1	3.7		
710 BRG FAILING/FAULTY				*	0.4	11.1	0.1	3.7		
900 BURNED OR OVERHEATED				*	0.4	11.1	0.8	24.8		
REPLACE	ON	D	1.3	1.0	2.5	66.8	3.3	96.4	1	1
020 WORN,CHAFED,FRAYED				*	2.1	55.6	2.7	78.9		
710 BRG FAILING/FAULTY				*	0.4	11.1	0.6	17.6		
COMPONENT TOTAL			1.[illegible]	1.0	3.8	100.0	4.3	100.0		

TABLE XXXVII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
29133 TRIPOD ASSY										
REPAIR	ON	O	1.5	1.2	6.7	37.2	10.3	48.5	2	2
020 WORN,CHAFED,FRAYED				*	1.3	7.0	3.5	16.7		
070 BROKEN				*	0.8	4.6	0.2	1.2		
710 BRG FAILING/FAULTY				*	0.8	4.6	2.7	12.8		
730 LOOSE				*	1.7	9.3	2.4	11.2		
REPLACE	ON	O	2.0	1.0	7.1	39.5	14.2	66.8	1	1
020 WORN,CHAFED,FRAYED				*	4.2	23.2	9.2	43.1		
710 BRG FAILING/FAULTY				*	0.8	4.7	1.2	5.6		
730 LOOSE				*	1.7	9.3	3.2	15.0		
OTHER			0.0		4.2	23.3	0.0	0.0		
COMPONENT TOTAL			1.4	1.1	18.0	100.0	24.5	100.0		
2931J DROOP COMP GEARBOX										
REPAIR	ON	O	0.7	1.2	22.1	80.3	15.5	62.6	1	1
127 ADJST/ALIGN IMPROPER				*	15.0	54.5	8.9	35.9		
315 RPM FLUCTUATION				*	2.1	7.5	0.8	3.2		
537 LOW POWER OR THRUST				*	1.3	4.6	0.6	2.5		
REPLACE	ON	O	2.3	1.8	3.3	12.1	7.7	31.0	2	2
127 ADJST/ALIGN IMPROPER				*	0.8	3.0	2.6	10.5		
OTHER			0.8	1.1	2.1	7.6	1.6	6.4		
COMPONENT TOTAL			0.9	1.3	27.6	100.0	24.8	100.0		
2931J10 LINEAR ACTUATOR										
REPAIR	ON	O	1.0	1.3	33.0	41.6	34.6	32.0	1	2
127 ADJST/ALIGN IMPROPER				*	20.1	25.3	20.8	19.2		
REPAIR	OFF	D	1.2	1.3	8.3	10.5	10.1	9.4	3	3
170 CORRODED				*	2.1	2.6	1.8	1.7		
REPLACE	ON	O	2.3	1.3	22.1	27.9	50.9	47.0	2	1
127 ADJST/ALIGN IMPROPER				*	6.3	7.9	14.4	13.3		
135 BINDING/STUCK/JAMMED				*	4.2	5.3	10.7	9.9		
242 NO OPER,REAS UNKNOWN				*	6.3	7.9	9.5	8.8		
OTHER			0.8	1.1	15.9	20.0	12.6	11.7		
COMPONENT TOTAL			1.4	1.3	79.3	100.0	108.3	100.0		

TABLE XXXVII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG.	AVG NO PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
29321 RPM WARN LMT DET/BOX										
CHECK	ON	O	1.3	1.5	8.8	5.5	11.6	5.4	4	4
799 NO DEFECT				*	8.3	5.2	7.4	3.4		
REPAIR	ON	O	1.2	1.4	53.0	33.2	63.5	29.4	1	2
127 ADJST/ALIGN IMPROPER				*	45.5	28.4	53.0	24.5		
REPAIR	OFF	O	1.1	1.2	44.7	27.9	49.3	22.8	3	3
127 ADJST/ALIGN IMPROPER				*	28.0	17.5	22.5	10.4		
615 SHORTED				*	12.5	7.8	19.3	8.9		
REPLACE	ON	O	2.4	1.4	49.7	31.1	119.3	55.3	2	1
242 NO OPER,REAS UNKNOWN				*	9.2	5.7	20.2	9.3		
374 INTERNAL FAILURE				*	12.5	7.8	25.4	11.8		
901 INTERMITTENT				*	5.9	3.7	13.8	6.4		
958 INCORRECT DISPLAY				*	7.1	4.4	14.3	6.6		
OTHER			0.0		3.8	2.4	0.0	0.0		
COMPONENT TOTAL			1.5	1.4	159.9	100.0	243.7	100.0		
29422 OIL COOLER										
REPAIR	ON	O	2.6	1.5	3.3	33.3	8.7	24.5	1	2
070 BROKEN				*	0.4	4.2	0.4	1.1		
127 ADJST/ALIGN IMPROPER				*	0.4	4.2	0.4	1.2		
190 CRACKED				*	0.4	4.2	0.4	1.2		
230 DIRTY				*	0.4	4.2	5.8	16.4		
381 LEAKING-INTERN/EXTER				*	1.3	12.5	1.3	3.5		
780 BENT,BUCKLED,ETC				*	0.4	4.2	0.4	1.2		
REPLACE	ON	O	4.2	1.7	2.9	29.1	12.3	34.3	2	1
190 CRACKED				*	0.4	4.2	1.6	4.5		
306 CONTAMINATION				*	0.4	4.2	0.6	1.7		
381 LEAKING-INTERN/EXTER				*	1.7	16.6	7.2	20.3		
900 BURNED OR OVERHEATED				*	0.4	4.2	2.8	7.9		
OTHER			3.9	1.7	3.8	37.5	14.7	41.2		
COMPONENT TOTAL			3.6	1.7	10.0	100.0	35.7	100.0		

TABLE XXXVII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
42211 STARTER GENERATOR										
CHECK	ON	O	1.0	1.4	7.1	21.3	7.4	8.2	2	4
799 NO DEFECT				*	7.1	21.3	7.4	8.2		
REPAIR	ON	D	2.2	1.4	12.1	36.2	26.9	29.7	1	1
020 WORN,CHAFED,FRAYED				*	1.2	3.7	0.7	0.7		
127 ADJUST/ALIGN IMPROPER				*	2.1	6.2	2.1	2.3		
374 INTERNAL FAILURE				*	0.8	2.5	3.1	3.5		
381 LEAKING-INTERN/EXTER				*	1.2	3.7	3.9	4.3		
437 IMPROP POSTND/SLCTD				*	0.8	2.5	2.1	2.3		
719 BROKEN GROUND WIRE				*	0.8	2.5	0.4	0.4		
INSTALL	ON	D	4.5	1.8	2.9	8.7	13.2	14.6	4	3
799 NO DEFECT				*	2.1	6.2	12.5	13.9		
REPLACE	ON	D	3.3	1.8	6.3	18.7	20.7	22.9	3	2
374 INTERNAL FAILURE				*	1.7	5.0	3.1	3.4		
800 NO-DEF/OTHER MAINT				*	0.8	2.5	3.6	4.0		
900 BURNED OR OVERHEATED				*	0.8	2.5	1.2	1.3		
OTHER			4.4	1.6	5.0	15.0	22.2	24.6		
COMPONENT TOTAL			2.7	1.6	33.4	100.0	90.4	100.0		
575C1 STAB CNTRL AMT SYS										
CHECK	ON	O	1.0	1.0	0.8	13.4	0.8	5.0	3	4
799 NO DEFECT				*	0.4	6.7	0.2	1.3		
958 INCORRECT DISPLAY				*	0.4	6.7	0.6	3.8		
REPAIR	ON	D	1.1	1.2	2.1	33.4	2.4	14.3	2	2
127 ADJUST/ALIGN IMPROPER				*	1.7	26.7	2.0	11.8		
169 INCORRECT VOLTAGE				*	0.4	6.7	0.4	2.5		
INSTALL	ON	D	3.0	3.0	0.4	6.7	1.3	7.5	4	3
799 NO DEFECT				*	0.4	6.7	1.3	7.5		
REPLACE	ON	D	2.0	1.4	2.5	40.1	5.0	30.1	1	1
242 NO OPER,REAS UNKNOWN				*	1.3	20.0	1.5	9.0		
561 UNABLE ADJ TO LIMITS				*	0.4	6.7	3.2	18.9		
901 INTERMITTENT				*	0.4	6.7	0.3	1.6		
958 INCORRECT DISPLAY				*	0.4	6.7	0.1	0.5		
OTHER			18.0	1.4	0.4	6.4	7.2	43.2		
COMPONENT TOTAL			2.7	1.4	6.3	100.0	16.7	100.0		

TABLE XXXVIII. COMPONENT MAINTENANCE REQUIREMENTS, CH-47 HELICOPTER

ACTION REASON/FAILURE MODE	ON/OFF A/C	LEV	MH/MA AVG	AVG NO MEN	MA/FH RATE	MA/FH PCNT	MH/FH RATE	MH/FH PCNT	R-A-N-K MA/FH	R-A-N-K MH/FH
14021 SWASH PLATE CONTROL										
REPLACE	ON	O	14.1		28.0	50.5	395.2	44.5	1	1
020 WORN,CHAFED,FRAYED				*	4.6	8.3				
799 NO DEFECT				*	11.2	20.2				
803 NO-DEF/TIME CHANGE				*	6.4	11.5				
CHECK	OFF	D	4.0		4.5	8.1	17.9	2.0	3	3
799 NO DEFECT				*	3.4	6.0				
REPAIR	OFF	D	12.0		5.1	9.1	60.8	6.9	2	2
OTHER			23.1		17.9	32.3	414.0	46.6		
COMPONENT TOTAL			16.0		55.5	100.0	887.9	100.0		
14060 DRIVE ARM ASSY-TRANS										
REPLACE	ON	O	1.8		30.9	53.9	55.5	25.5	1	1
020 WORN,CHAFED,FRAYED				*	12.2	21.2				
730 LOOSE				*	1.8	3.1				
799 NO DEFECT				*	4.9	8.6				
803 NO-DEF/TIME CHANGE				*	4.9	8.5				
CHECK	OFF	D	3.0		10.3	18.0	31.3	14.4	2	3
REPAIR	OFF	D	6.0		6.7	11.7	40.3	18.5	3	2
730 LOOSE				*	1.9	3.4				
OTHER			9.6		9.4	16.5	90.8	41.7		
COMPONENT TOTAL			3.8		57.3	100.0	217.9	100.0		
15008 HEAD-ROTARY WING ASSY										
REPLACE	ON	D	10.8		91.1	42.6	983.9	17.5	1	3
020 WORN,CHAFED,FRAYED				*	11.0	5.1				
381 LEAKING-INTERN/EXTER				*	5.5	2.6				
799 NO DEFECT				*	28.8	13.5				
803 NO-DEF/TIME CHANGE				*	11.9	5.6				
CHECK	OFF	D	60.0		23.6	11.0	1413.5	25.2	3	2
799 NO DEFECT				*	9.4	4.4				
REPAIR	OFF	D	80.0		25.0	11.7	2003.9	35.7	2	1
OTHER			16.5		73.9	34.6	1216.6	21.7		
COMPONENT TOTAL			26.3		213.7	100.0	5617.9	100.0		

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ FA AVG	AVG AC PER	FA/ FH RATE	FA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-1-4-5 FA/ FH	R-1-4-5 MH/ FH
15102 DAMPENER,FLUTTER,ROTOR										
REPLACE	ON	0	2.3		30.1	90.2	69.3	91.7	1	1
020 WORN,CHAFED,FRAYED				*	7.3	21.7				
127 ADJST/ALIGN IMPROPER				*	1.5	4.6				
374 INTERNAL FAILURE				*	1.9	5.7				
381 LEAKING-INTERN/EXTER				*	9.2	27.4				
OTHER			1.9		3.3	9.8	6.3	8.3		
COMPONENT TOTAL			2.3		33.4	100.0	75.5	100.0		
15133 BOOT ASSY-ROTOR HEAD										
REPLACE	ON	0	1.9		43.8	88.3	83.3	181.5	1	1
020 WORN,CHAFED,FRAYED				*	9.1	18.3				
070 BROKEN				*	9.9	19.9				
799 NO DEFECT				*	1.8	3.6				
9· TORN				*	11.4	23.0				
REPAIR	ON	0	1.5		3.9	7.8	6.0	13.0	2	2
OTHER			0.6		1.9	3.9	0.0	0.0		
COMPONENT TOTAL			1.8		49.6	100.0	89.2	100.0		
15170 SIGHT CUP-OIL TANK										
REPLACE	ON	0	1.2		39.1	99.2	46.9	146.3	1	1
070 BROKEN				*	20.0	50.8				
190 CRACKED				*	10.9	27.7				
381 LEAKING-INTERN/EXTER				*	3.2	8.0				
OTHER			0.0		0.3	0.8	0.0	0.0		
COMPONENT TOTAL			1.2		39.4	100.0	46.9	100.0		
15234 SPRING,DROOP STOP,AFT										
REPLACE	ON	0	1.7		11.9	95.3	20.3	142.4	1	1
020 WORN,CHAFED,FRAYED				*	5.2	41.9				
070 BROKEN				*	1.4	11.4				
664 TENSION INCORRECT				*	1.0	7.6				
OTHER			0.0		0.6	4.7	0.0	0.0		
COMPONENT TOTAL			1.6		12.5	100.0	20.3	100.0		

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ FA AVG	AVG AD PER	FA/ FH RATE	FA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-R-K FA/ FH	R-A-R-K MH/ FH
15271 DROOP STOP										
REPLACE	ON	O	1.6		1.2	20.5	1.9	22.0	3	3
020 WORN,CHAFED,FRAYED				*	0.1	2.6				
093 MISSING PART				*	0.1	2.6				
127 ADJST/ALIGN IMPROPER				*	0.2	3.8				
800 NO-DEF/OTHER MAINT				*	0.4	7.7				
804 NO-DEF/SCHED MAINT				*	0.2	3.8				
CHECK	ON	O	1.6		1.9	53.4	3.4	39.4	1	1
799 NO DEFECT				*	1.9	33.4				
ADJUST	ON	O	1.3		1.8	30.8	2.4	27.5	2	2
127 ADJST/ALIGN IMPROPER				*	1.8	30.8				
REPAIR	ON	O	1.0		0.8	12.9	0.8	8.7	4	4
127 ADJST/ALIGN IMPROPER				*	0.2	3.2				
567 RESISTANCE INCORRECT				*	0.2	3.2				
799 NO DEFECT				*	0.2	3.2				
800 NO-DEF/OTHER MAINT				*	0.2	3.2				
OTHER			1.5		0.1	2.4	0.2	2.4		
COMPONENT TOTAL			1.5		5.8	100.0	8.6	100.0		
22004 ENGINE,AIRCRAFT,TURBINE										
REPLACE	ON	D	77.6		128.9	18.4	10000.0	76.3	1	1
020 WORN,CHAFED,FRAYED				*	25.8	3.7				
070 BROKEN				*	18.3	2.6				
156 MISSING HARDWARE				*	9.1	1.3				
799 NO DEFECT				*	9.9	1.4				
CHECK	OFF	D	38.0		73.2	10.4	2779.3	21.2	2	3
799 NO DEFECT				*	24.4	3.5				
REPAIR	OFF	D	79.9		49.9	7.1	3995.0	30.5	3	2
OTHER			0.0		445.9	64.0	0.0	0.0		
COMPONENT TOTAL			23.9		700.9	100.0	16772.2	100.0		

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
22074 SENSING ELEMENT,FIRE DET										
REPLACE	ON	O	1.7		82.8	87.5	140.7	107.3	1	1
020 WORN,CHAFED,FRAYED				*	25.4	26.9				
070 BROKEN				*	26.9	28.4				
780 BENT,BUCKLED,ETC				*	5.0	5.3				
REPAIR	ON	O	2.3		6.0	6.3	13.7	10.5	2	2
OTHER			0.0		5.8	6.2	0.0	0.0		
COMPONENT TOTAL			1.6		94.5	100.0	154.4	100.0		
22101 PUMP,OIL,ENGINE										
REPLACE	ON	O	5.4		6.1	63.1	33.0	41.6	1	1
020 WORN,CHAFED,FRAYED				*	0.6	5.9				
374 INTERNAL FAILURE				*	0.8	7.9				
381 LEAKING-INTERN/EXTER				*	2.6	27.0				
410 LACK OF/IMPROP LUBE				*	0.4	3.9				
800 NO-DEF/OTHER MAINT				*	0.3	3.0				
ADJUST	ON	O	3.0		0.6	6.2	1.8	2.3	3	3
127 ADJST/ALIGN IMPROPER				*	0.4	4.1				
REPAIR	ON	O	2.0		1.3	13.6	2.7	3.4	2	2
020 WORN,CHAFED,FRAYED				*	0.5	5.2				
OTHER			25.5		1.6	16.9	41.5	52.7		
COMPONENT TOTAL			8.2		9.7	100.0	79.4	100.0		
22128 ACTUATOR ELEC/MECH,N2										
REPLACE	ON	O	2.3		17.4	87.0	40.0	80.0	1	1
020 WORN,CHAFED,FRAYED				*	1.7	8.4				
070 BROKEN				*	1.9	9.6				
127 ADJST/ALIGN IMPROPER				*	1.7	8.4				
374 INTERNAL FAILURE				*	4.9	24.[illegible]				
900 BURNED OR OVERHEATED				*	1.0	5.1				
CHECK	ON	O	1.7		1.3	6.7	2.3	4.6	2	2
OTHER			6.1		1.3	6.3	7.7	15.4		
COMPONENT TOTAL			2.5		20.0	100.0	50.0	100.0		

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
22157 STARTER,ENGINE,HYD										
REPLACE	ON	0	2.6		21.5	94.7	55.8	150.2	1	1
020 WORN,CHAFED,FRAYED				*	1.4	6.2				
374 INTERNAL FAILURE				*	4.2	18.4				
381 LEAKING-INTERN/EXTER				*	10.4	45.9				
799 NO DEFECT				*	1.4	6.2				
OTHER			0.0		1.2	5.3	0.0	0.0		
COMPONENT TOTAL			2.5		22.7	100.0	55.8	100.0		
22310 CONE,EXHAUST,ENGINE										
REPLACE	ON	0	1.7		5.2	97.2	8.9	150.4	1	1
070 BROKEN				*	2.4	44.2				
190 CRACKED				*	1.2	22.1				
OTHER			C.		0.1	2.8	0.0	0.0		
COMPONENT TOTAL			1		5.4	100.0	8.9	100.0		
22357 TAILPIPE,ENGINE										
REPLACE	ON	0	1.6		1.0	87.4	1.9	55.8	1	1
093 MISSING PART				*	0.2	17.5				
190 CRACKED				*	0.6	52.4				
REPAIR	ON	0	3.0		0.1	12.6	0.4	13.4	2	2
OTHER			3.0		0.0	0.0	1.0	30.7		
COMPONENT TOTAL			2.9		1.2	100.0	3.3	100.0		
24009 ENGINE,APU										
REPLACE	ON	0	5.4		52.2	50.7	281.8	8.7	1	2
020 WORN,CHAFED,FRAYED				*	8.9	8.7				
070 BROKEN				*	7.3	7.1				
374 INTERNAL FAILURE				*	7.7	7.5				
381 LEAKING-INTERN/EXTER				*	2.8	2.7				
799 NO DEFECT				*	3.2	3.1				
CHECK	OFF	0	16.0		15.2	14.8	243.3	7.5	3	3
799 NO DEFECT				*	5.7	5.5				
804 NO-DEF/SCHED MAINT				*	2.9	2.8				
REPAIR	ON	0	2.0		7.4	7.2	15.0	0.5	4	4
070 BROKEN				*	2.7	2.6				

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PER	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	S-A-R-K MA/ FH	MH/ FH
REPAIR	OFF	O	117.7		15.5	15.1	1825.0	56.2	2	1
381 LEAKING-INTERN/EXTER				*	3.8	3.6				
OTHER			70.5		12.5	12.2	883.5	27.2		
COMPONENT TOTAL			31.6		102.9	100.0	3248.8	100.0		
24169 MOTOR PUMP,HYD,APU										
REPLACE	ON	O	3.1		2.7	63.4	8.5	21.1	1	2
020 WORN,CHAFED,FRAYED				*	0.2	5.4				
093 MISSING PART				*	0.2	5.4				
135 BINDING/STUCK/JAMMED				*	0.5	10.7				
374 INTERNAL FAILURE				*	0.2	5.4				
381 LEAKING-INTERN/EXTER				*	1.4	32.3				
800 NO-DEF/OTHER MAINT				*	0.2	4.6				
ADJUST	ON	O	2.7		0.3	6.9	0.8	2.5	3	3
127 ADJUST/ALIGN IMPROPER				*	0.1	3.5				
135 BINDING/STUCK/JAMMED				*	0.1	3.5				
REPAIR	OFF	O	18.9		1.3	31.0	25.3	77.8	2	1
070 BROKEN				*	0.7	15.5				
190 CRACKED				*	0.5	11.8				
381 LEAKING-INTERN/EXTER				*	0.2	4.0				
COMPONENT TOTAL			7.9		4.4	100.0	34.6	100.0		
24304 SWITCH,FUEL PRESS APU										
REPLACE	ON	O	1.4		3.1	100.0	4.4	69.0	1	1
0 3 OPEN TUBE FILAMENT				*	0.2	5.0				
020 WORN,CHAFED,FRAYED				*	0.2	5.0				
093 MISSING PART				*	0.2	5.0				
127 ADJUST/ALIGN IMPROPER				*	0.3	10.0				
374 INTERNAL FAILURE				*	0.1	4.0				
381 LEAKING-INTERN/EXTER				*	0.3	10.0				
900 NO-DEF/OTHER MAINT				*	0.2	5.0				
910 CHIPPED				*	0.2	5.0				
OTHER			1.4		0.0	0.0	2.0	31.0		
COMPONENT TOTAL			2.0		3.1	100.0	6.3	100.0		

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
24376 PUMP,FUEL,APU										
REPLACE	ON	O	1.8		2.4	100.0	4.3	152.5	1	1
070 BROKEN				*	0.3	13.3				
093 MISSING PART				*	0.5	20.0				
374 INTERNAL FAILURE				*	0.6	26.7				
381 LEAKING-INTERN/EXTER				*	0.2	6.7				
800 NO-DEF/OTHER MAINT				*	0.2	6.7				
900 BURNED OR OVERHEATED				*	0.2	6.7				
COMPONENT TOTAL			1.8		2.4	100.0	4.3	100.0		
26010 TRANS ASSY,COMBINING										
REPLACE	ON	D	7.6		54.7	44.3	416.0	16.3	1	1
020 WORN,CHAFED,FRAYED				*	11.0	8.9				
381 LEAKING-INTERN/EXTER				*	10.4	8.4				
799 NO DEFECT				*	6.4	5.2				
803 NO-DEF/TIME CHANGE				*	10.0	8.1				
CHECK	OFF	D	12.0		14.9	12.1	178.9	7.0	3	3
REPAIR	ON	D	1.2		14.3	11.6	16.9	0.7	4	4
800 NO-DEF/OTHER MAINT				*	6.7	5.4				
REPAIR	OFF	D	23.9		15.7	12.7	375.7	14.7	2	2
135 BINDING/STUCK/JAMMED				*	1.2	0.9				
381 LEAKING-INTERN/EXTER				*	2.4	1.9				
710 BRG FAILING/FAULTY				*	1.2	0.9				
OTHER			65.2		23.9	19.4	1560.9	61.2		
COMPONENT TOTAL			20.6		123.6	100.0	2548.5	100.0		
26012 SHAFT ASSY,SYNC ROTOR										
REPLACE	ON	O	2.4		76.5	34.5	183.7	9.1	1	1
020 WORN,CHAFED,FRAYED				*	6.0	2.7				
780 BENT,BUCKLED,ETC				*	6.4	2.9				
799 NO DEFECT				*	15.5	7.0				
800 NO-DEF/OTHER MAINT				*	4.4	2.0				
803 NO-DEF/TIME CHANGE				*	9.6	4.3				

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
CHECK	OFF	D	4.0		31.2	14.1	124.7	6.2	2	2
OTHER			15.0		114.2	51.4	1713.7	84.7		
COMPONENT TOTAL			9.1		221.9	100.0	2022.1	100.0		
26013 TRANS ASSY,AFT ROTOR										
REPLACE	ON	D	42.6		36.5	51.8	1556.2	92.8	2	1
093 MISSING PART				*	3.7	5.3				
381 LEAKING-INTERN/EXTER				*	4.0	5.7				
799 NO DEFECT				*	11.0	15.6				
800 NO-DEF/OTHER MAINT				*	7.7	11.0				
803 NO-DEF/TIME CHANGE				*	2.7	3.8				
CHECK	OFF	D	12.0		3.6	5.1	42.9	2.6	3	2
799 NO DEFECT				*	3.0	4.2				
REPAIR	ON	D	0.2		71.6	101.5	11.4	0.7	1	3
020 WORN,CHAFED,FRAYED				*	5.1	7.2				
070 BROKEN				*	10.2	14.5				
170 CORRODED				*	5.1	7.2				
230 DIRTY				*	5.1	7.2				
381 LEAKING-INTERN/EXTER				*	5.1	7.2				
540 PUNCTURED				*	5.1	7.2				
730 LOOSE				*	15.3	21.7				
800 NO-DEF/OTHER MAINT				*	10.2	14.5				
804 NO-DEF/SCHED MAINT				*	5.1	7.2				
OTHER			0.2		0.0	0.0	65.8	3.9		
COMPONENT TOTAL			15.0		111.7	100.0	1676.3	100.0		
26016 TRANS ASSY,FWD ROTOR										
REPLACE	ON	D	39.0		24.6	46.6	959.4	71.4	1	1
020 WORN,CHAFED,FRAYED				*	3.5	6.7				
381 LEAKING-INTERN/EXTER				*	5.4	10.3				
799 NO DEFECT				*	3.8	7.3				
803 NO-DEF/TIME CHANGE				*	2.6	4.8				
CHECK	OFF	D	12.0		3.4	6.5	41.1	3.1	4	3
799 NO DEFECT				*	2.3	4.3				

TABLE XXXVIII - Continued

ACTION / REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
REPAIR	ON	O	0.6		7.0	13.3	3.9	0.3	3	4
REPAIR	OFF		24.0		8.6	16.4	207.5	15.4	2	2
372 METAL ON MAGNET PLUG				*	1.3	2.5				
OTHER					9.1	17.2	132.5	9.9		
COMPONENT TOTAL			[illegible]		52.8	100.0	1344.4	100.0		
26017 TRANS ASSY,ENGINE										
REPLACE	ON	O	4.5		47.4	29.9	213.4	16.9	2	3
020 WORN,CHAFED,FRAYED				*	8.2	5.2				
381 LEAKING-INTERN/EXTER				*	4.5	2.8				
799 NO DEFECT				*	5.1	3.2				
803 NO-DEF/TIME CHANGE				*	4.1	2.6				
CHECK	OFF	D	4.2		53.2	33.6	221.9	17.5	1	2
092 MISMATCHED				*	4.1	2.6				
799 NO DEFECT				*	24.6	15.5				
800 NO-DEF/OTHER MAINT				*	8.2	5.2				
REPAIR	OFF	D	12.2		32.9	20.8	402.6	31.8	3	1
381 LEAKING-INTERN/EXTER				*	5.5	3.5				
OTHER			17.2		24.8	15.6	426.6	33.7		
COMPONENT TOTAL			8.0		158.3	100.0	1254.4	100.0		
26019 SHAFT ASSY,TRANS										
REPLACE	ON	D	2.1		24.6	27.1	51.7	5.5	1	3
799 NO DEFECT				*	3.6	3.9				
020 WORN,CHAFED,FRAYED				*	2.7	3.0				
803 NO-DEF/TIME CHANGE				*	2.5	2.7				
CHECK	ON	O	4.0		19.5	21.5	78.1	8.3	2	2
799 NO DEFECT				*	6.5	7.2				
800 NO-DEF/OTHER MAINT				*	3.3	3.6				
REPAIR	OFF	O	13.9		5.7	6.3	78.7	8.4	3	1
OTHER			18.0		40.8	45.1	734.3	77.9		
COMPONENT TOTAL			10.4		90.6	100.0	942.8	100.0		

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AV NC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
26038 SHAFT ASSY,AFT DRIVE										
REPLACE	ON	D	19.7		11.2	35.2	220.2	51.0	1	1
020 WORN,CHAFED,FRAYED				*	1.8	5.6				
381 LEAKING-INTERN/EXTER				*	1.4	4.3				
799 NO DEFECT				*	3.0	9.5				
803 NO-DEF/TIME CHANGE				*	1.4	4.5				
CHECK	OFF	D	4.0		6.1	19.2	24.4	5.7	2	3
799 NO DEFECT				*	3.1	9.6				
803 NO-DEF/TIME CHANGE				*	1.0	3.2				
804 NO-DEF/SCHED MAINT				*	1.0	3.2				
REPAIR	ON	D	2.6		1.5	4.7	3.9	0.9	4	4
REPAIR	OFF	D	10.4		3.3	10.3	34.0	7.9	3	2
OTHER			15.4		9.7	30.5	149.5	34.6		
COMPONENT TOTAL			13.6		31.8	100.0	432.1	100.0		
26084 ADAPTER ASSY,ROTOR DRIVE										
REPLACE	ON	D	2.2		6.1	31.6	13.4	12.6	2	2
020 WORN,CHAFED,FRAYED				*	1.0	5.3				
799 NO DEFECT				*	1.5	7.9				
780 BENT,BUCKLED,ETC				*	0.8	4.0				
804 NO-DEF/SCHED MAINT				*	0.8	4.0				
CHECK	OFF	D	4.0		2.8	14.7	11.3	10.7	3	3
799 NO DEFECT				*	1.7	8.8				
REPAIR	OFF	D	8.0		9.8	51.2	78.7	74.0	1	1
070 BROKEN				*	0.7	3.4				
190 CRACKED				*	0.7	3.4				
690 VIBRATION EXCESSIVE				*	1.3	6.8				
803 NO-DEF/TIME CHANGE				*	2.6	13.7				
910 CHIPPED				*	2.0	10.2				
OTHER			6.4		0.4	2.3	2.9	2.7		
COMPONENT TOTAL			5.5		19.2	100.0	106.4	100.0		

TABLE XXXVIII - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
26086 SEAL,TRANS										
REPLACE	ON	0	15.0		21.5	92.3	322.0	308.0	1	1
020 WORN,CHAFED,FRAYED				*	3.3	14.0				
381 LEAKING-INTERN/EXTER				*	12.7	54.6				
OTHER			0.0		1.8	7.7	0.0	0.0		
COMPONENT TOTAL			13.8		23.3	100.0	322.0	100.0		
26173 CHIP DETECTOR,MAG TRANS										
REPLACE	ON	0	1.1		7.2	16.0	7.9	26.7	1	1
070 BROKEN				*	2.0	4.4				
381 LEAKING-INTERN/EXTER				*	0.5	1.1				
REPAIR	ON	0	1.1		3.1	7.0	3.4	11.5	2	2
070 BROKEN				*	2.0	4.5				
OTHER			0.5		34.6	77.0	18.3	61.8		
COMPONENT TOTAL			0.7		44.9	100.0	29.7	100.0		
42054 GENERATOR,AC										
REPLACE	ON	0	1.8		22.7	58.7	40.8	15.9	1	!
020 WORN,CHAFED,FRAYED				*	1.2	3.2				
093 MISSING PART				*	1.2	3.2				
374 INTERNAL FAILURE				*	5.2	13.4				
799 NO DEFECT				*	1.7	4.5				
900 BURNED OR OVERHEATED				*	1.7	4.5				
REPAIR	ON	0	9.9		6.7	17.4	66.3	25.8	2	1
020 WORN,CHAFED,FRAYED				*	2.8	7.3				
070 BROKEN				*	1.1	2.7				
OTHER			16.2		[illegible]	24.0	149.5	58.3		
COMPONENT TOTAL			6.6		[illegible]	100.0	256.7	100.0		
45011 SERVO CYLINDER,HYD										
REPLACE	ON	0	3.7		44.4	[illegible]	164.4	6.7	2	2
381 LEAKING-INTERN/EXTER				*	15.5	8.2				
799 NO DEFECT				*	7.1	3.7				
CHECK	OFF	D	4.0		17.6	9.3	70.4	2.9	3	3
REPAIR	OFF	D	12.0		70.7	37.3	848.1	34.7	1	1
135 BINDING/STUCK/JAMMED				*	7.1	3.7				
381 LEAKING-INTERN/EXTER				*	17.7	9.3				
OTHER			24.0		56.8	30.0	1359.8	55.7		
COMPONENT TOTAL			12.9		189.5	100.0	2443.7	100.0		

TABLE XXXIX. COMPONENT MAINTENANCE REQUIREMENTS, CH-54 HELICOPTER

ALTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
15006 TAIL ROTOR BLADE										
REPLACE	ON	O	2.9		87.7	17.9	254.4	6.3	4	4
190 CRACKED				*	37.2	7.6				
CHECK	OFF	O	8.0		94.2	19.2	753.3	18.6	3	2
799 NO DEFECT				*	25.7	5.2				
REPAIR	ON	D	3.3		119.8	24.5	399.6	9.9	2	3
070 BROKEN				*	14.4	2.9				
190 CRACKED				*	81.5	16.6				
REPAIR	OFF	D	16.0		159.4	-32.5	2551.3	62.9	1	1
190 CRACKED				*	81.3	16.6				
OTHER			3.4		28.9	5.9	98.0	2.4		
COMPONENT TOTAL			8.3		490.0	100.0	4056.6	100.0		
15007 MAIN ROTOR HEAD ASSY										
REPLACE	ON	D	28.7		38.5	42.3	1105.5	29.9	1	2
020 WORN,CHAFED,FRAYED				*	6.4	7.1				
070 BROKEN				*	3.2	3.5				
799 NO DEFECT				*	5.5	6.0				
800 NO-DEF/OTHER MAINT				*	4.3	4.7				
803 NO-DEF/TIME CHANGE				*	9.8	10.7				
804 NO-DEF/SCHED MAINT				*	2.2	2.5				
CHECK	ON	O	7.7		6.4	7.1	49.4	1.3	3	3
CHECK	OFF	O	59.9		22.5	24.7	1348.2	36.5	2	1
OTHER			50.7		23.6	25.9	1195.1	32.3		
COMPONENT TOTAL			40.6		91.0	100.0	3698.3	100.0		
15016 ROTARY DAMPER ASSEMBLY										
REPLACE	ON	O	3.2		32.2	334.5	103.1	9.9	1	3
020 WORN,CHAFED,FRAYED				*	5.5	57.2				
070 BROKEN				*	1.8	19.0				
093 MISSING PART				*	1.8	19.0				
381 LEAKING-INTERN/EXTER				*	12.8	132.5				
540 PUNCTURED				*	1.8	19.0				
748 FREQ ERRATIC/INCORCT				*	1.8	19.0				
800 NO-DEF/OTHER MAINT				*	3.2	33.3				
804 NO-DEF/SCHED MAINT				*	1.8	19.0				

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
CHECK	OFF	D	8.0		32.1	333.3	256.8	24.7	2	1
REPAIR	OFF	D	16.0		9.6	100.0	154.1	14.8	3	2
127 ADJST/ALIGN IMPROPER				*	1.1	11.1				
381 LEAKING-INTERN/EXTER				*	2.1	22.2				
690 VIBRATION EXCESSIVE				*	6.5	67.0				
OTHER			16.0		0.0	0.0	523.9	50.5		
COMPONENT TOTAL			14.0		73.9	100.0	1037.9	100.0		
15021 TAIL ROTOR HEAD ASSY										
REPLACE	ON	O	9.8		31.0	69.0	304.1	40.9	1	2
020 WORN,CHAFED,FRAYED				*	4.9	11.0				
374 INTERNAL FAILURE				*	1.6	3.7				
381 LEAKING-INTERN/EXTER				*	8.2	18.2				
799 NO DEFECT				*	6.4	14.3				
800 NO-DEF/OTHER MAINT				*	1.6	3.7				
803 NO-DEF/TIME CHANGE				*	8.2	18.2				
CHECK	OFF	D	40.0		9.6	21.4	385.2	51.8	2	1
799 NO DEFECT				*	2.1	4.8				
REPAIR	ON	O	3.3		3.2	7.1	10.7	1.4	3	3
730 LOOSE				*	3.2	7.1				
OTHER			40.5		1.1	2.4	43.3	5.8		
COMPONENT TOTAL			16.5		44.9	100.0	743.3	100.0		
15079 DROOP RESTRAINER										
REPLACE	ON	O	1.5		43.9	99.9	65.8	52.5	1	1
020 WORN,CHAFED,FRAYED				*	10.7	24.4				
070 BROKEN				*	10.7	24.5				
093 MISSING PART				*	2.7	6.1				
135 BINDING/STUCK/JAMMED				*	9.1	20.8				
190 CRACKED				*	2.7	6.1				
760 BENT,BUCKLED,ETC				*	8.0	18.3				
OTHER			*****		0.0	0.1	59.6	47.5		
COMPONENT TOTAL			2.9		43.9	100.0	125.4	100.0		

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG MC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	 MH/ FH
15208 BEARING										
REPLACE	ON	0	1.4		[illegible]7.8	96.2	39.0	48.5	1	1
020 WORN,CHAFED,FRAYED				*	24.2	83.7				
OTHER			37.6		1.1	3.8	41.3	51.5		
COMPONENT TOTAL			2.8		28.9	100.0	80.3	100.0		
22005 ENGINE										
REPLACE	ON	0	52.8		117.7	33.6	6213.5	100.6	1	1
799 NO DEFECT				*	16.6	4.8				
804 NO-DEF/SCHED MAINT				*	12.4	3.5				
CHECK	OFF	0	40.0		23.5	6.7	941.7	15.2	5	3
ADJUST	ON	0	3.2		78.1	22.3	247.9	4.0	2	5
127 ADJST/ALIGN IMPROPER				*	44.4	12.7				
REPAIR	ON	0	6.9		50.3	14.4	347.3	5.6	3	4
190 CRACKED				*	12.6	3.6				
REPAIR	OFF	0	80.0		24.6	7.0	1968.8	31.9	4	2
OTHER			0.0		55.6	15.9	0.0	0.0		
COMPONENT TOTAL			27.8		349.9	100.0	9719.2	100.0		
22028 TAIL PIPE ASSY										
REPLACE	ON	0	1.8		113.4	87.6	204.2	41.[illegible]	1	1
020 WORN,CHAFED,FRAYED				*	7.9	6.1				
070 BROKEN				*	39.6	30.6				
190 CRACKED				*	52.7	40.7				
REPAIR	ON	0	2.4		12.8	9.9	31.1	6.3	2	2
190 CRACKED				*	7.5	5.8				
OTHER			80.4		3.2	2.5	258.0	52.3		
COMPONENT TOTAL			3.8		129.5	100.0	493.3	100.0		
22037 FUEL CONTROL										
REPLACE	ON	0	6.4		22.5	72.4	143.8	48.7	1	1
020 WORN,CHAFED,FRAYED				*	1.2	3.8				
537 LOW POWER OR THRUST				*	1.2	3.8				
374 INTERNAL FAILURE				*	2.4	7.6				
127 ADJST/ALIGN IMPROPER				*	1.2	3.8				
381 LEAKING-INTERN/EXTER				*	9.5	30.5				
803 NO-DEF/TIME CHANGE				*	2.4	7.6				

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
ADJUST	ON	O	1.0		4.3	13.8	4.3	1.4	2	2
127 ADJST/ALIGN IMPROPER				*	4.3	13.8				
OTHER			34.4		4.3	13.8	147.1	49.8		
COMPONENT TOTAL			9.5		31.0	100.0	295.2	100.0		
22043 PARTICLE SEPARATOR										
REPLACE	ON	O	5.5		7.5	46.7	41.2	15.9	1	1
020 WORN,CHAFED,FRAYED				*	1.3	8.3				
070 BROKEN				*	1.3	8.3				
093 MISSING PART				*	1.3	8.3				
800 NO-DEF/OTHER MAINT				*	1.3	8.3				
799 NO DEFECT				*	2.1	13.3				
CHECK	OFF	O	8.0		3.2	20.0	25.7	9.9	2	2
800 NO-DEF/OTHER MAINT				*	1.1	6.7				
OTHER			36.0		5.3	33.3	192.6	74.2		
COMPONENT TOTAL			16.2		16.0	100.0	259.5	100.0		
22100 EAPS BLOWER										
REPLACE	ON	O	3.4		15.0	73.8	51.0	63.4	1	1
038 NOISY				*	1.4	6.7				
020 WORN,CHAFED,FRAYED				*	6.9	33.9				
070 BROKEN				*	1.4	6.7				
246 IMPROP/FAULTY MAINT				*	1.4	6.7				
330 EXCESSIVE HUM				*	1.4	6.7				
374 INTERNAL FAILURE				*	2.7	13.4				
OTHER			5.5		5.3	26.2	29.5	36.6		
COMPONENT TOTAL			4.0		20.3	100.0	80.5	100.0		
22150 STARTER										
REPLACE	ON	O	2.6		7.5	77.9	19.5	41.9	2	1
381 LEAKING-INTERN/EXTER				*	7.5	77.9				
CHECK	ON	O	0.1		21.4	222.2	1.6	3.4	1	2
OTHER			0.1		0.0	0.0	25.4	54.7		
COMPONENT TOTAL			1.6		28.9	100.0	46.5	100.0		

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PER	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
22113 ANTI ICING VALVE										
REPLACE	ON	0	1.3		15.0	87.6	19.5	27.4	1	1
020 WORN,CHAFED,FRAYED				*	1.5	8.8				
070 BROKEN				*	1.5	8.8				
106 MISSING HARDWARE				*	1.5	8.8				
374 INTERNAL FAILURE				*	3.0	17.5				
381 LEAKING-INTERN/EXTER				*	1.5	8.8				
450 OPEN				*	1.5	8.8				
900 BURNED OR OVERHEATED				*	3.0	17.5				
CHECK	ON	0	1.5		1.1	6.4	1.6	2.[illegible]	2	2
OTHER			49.1		1.0	6.0	50.1	70.4		
COMPONENT TOTAL			4.2		17.1	100.0	71.2	100.0		
22389 ANTI ICE SENSOR										
REPLACE	ON	0	1.9		2.1	66.7	4.1	69.2	1	1
730 LOOSE				*	2.1	66.7				
REPAIR	ON	0	0.5		1.1	33.3	0.5	9.0	2	2
070 BROKEN				*	1.1	33.3				
OTHER			0.5		0.0	0.0	1.3	21.8		
COMPONENT TOTAL			1.8		3.2	100.0	5.9	100.0		
24014 APP ENGINE										
REPLACE	ON	0	6.4		2.1	9.5	13.7	1.2	3	3
070 BROKEN				*	1.1	4.8				
410 LACK OF/IMPROP LUBE				*	1.1	4.8				
CHECK	OFF	0	40.0		6.4	28.6	256.8	22.3	2	2
REPAIR	ON	0	60.0		13.9	61.9	834.6	72.6	1	1
135 BINDING/STUCK/JAMMED				*	1.1	4.8				
374 INTERNAL FAILURE				*	6.4	28.6				
381 LEAKING-INTERN/EXTER				*	1.1	4.8				
710 BRG FAILING/FAULTY				*	1.1	4.8				
OTHER			60.0		0.0	0.0	44.4	3.9		
COMPONENT TOTAL			51.2		22.5	100.0	1149.5	100.0		

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/OFF A/C	LEV	MH/MA AVG	AVG AC MEN	MA/FH RATE	MA/FH PCNT	MH/FH RATE	MH/FH PCNT	R-A-N-K MA/FH	R-A-N-K MH/FH
24[illegible] APP CLUTCH ASSY										
REPLACE	ON	O	2.3		16.1	51.9	37.0	13.2	1	2
[illegible] NOISY				*	1.3	4.2				
320 WORN,CHAFED,FRAYED				*	1.3	4.2				
381 LEAKING-INTERN/EXTER				*	5.[illegible]	28.0				
382 LIQUID LOCK				*	1.3	4.7				
799 NO DEFECT				*	2.[illegible]	8.0				
CHECK	OFF	O	8.0		3.2	10.3	25.7	9.2	3	3
REPAIR	ON	O	2.8		2.1	6.9	5.9	2.1	4	4
REPAIR	OFF	O	16.0		6.4	20.7	102.7	35.7	2	1
OTHER			34.5		3.2	10.2	105.9	38.9		
COMPONENT TOTAL			9.0		31.0	100.0	280.2	100.0		
24040 APP FUEL CONTROL										
REPLACE	ON	O	3.4		19.3	75.0	65.5	64.0	1	1
793 MISSING PART				*	1.1	4.2				
127 ADJUST/ALIGN IMPROPER				*	1.1	4.2				
236 DIRTY				*	1.1	4.2				
315 RPM FLUCTUATION				*	1.1	4.7				
374 INTERNAL FAILURE				*	2.1	8.3				
381 LEAKING-INTERN/EXTER				*	1.1	4.2				
525 PRESSURE INCORRECT				*	3.2	12.5				
910 CHIPPED				*	1.1	4.2				
ADJUST	ON	O	0.8		5.3	20.8	4.3	4.2	2	2
127 ADJUST/ALIGN IMPROPER				*	3.2	12.5				
OTHER			30.4		1.1	4.2	32.5	31.8		
COMPONENT TOTAL			4.0		25.7	100.0	102.3	100.0		
24159 APP STARTER										
REPLACE	ON	O	3.1		12.8	100.0	39.8	99.7	1	1
070 BROKEN				*	3.5	27.3				
135 BINDING/STUCK/JAMMED				*	1.2	9.1				
190 CRACKED				*	1.2	9.1				
374 INTERNAL FAILURE				*	3.5	27.3				
585 SHEARED				*	1.2	9.1				
800 NO-DEF/OTHER MAINT				*	1.2	9.1				
OTHER			3.1		0.0	0.0	0.1	0.3		
COMPONENT TOTAL			3.1		12.8	100.0	39.9	100.0		

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
24167 APP FUEL PUMP										
REPLACE	ON	O	4.4		3.2	59.4	14.1	45.0	1	1
135 BINDING/STUCK/JAMMED				*	1.1	19.8				
374 INTERNAL FAILURE				*	2.2	39.8				
CHECK	ON	O	0.0		2.1	39.6	0.0	0.0	2	0
OTHER			345.6		0.0	0.9	17.3	5_.0		
COMPONENT TOTAL			5.8		5.4	100.0	31.4	100.0		
26011 MAIN GEAR BOX										
REPLACE	ON	O	97.7		22.5	15.6	2199.2	101.2	1	1
803 NO-DEF/TIME CHANGE				*	5.7	3.9				
CHECK	OFF	O	48.0		9.6	6.7	462.2	21.3	2	2
OTHER			0.0		112.4	77.8	0.0	0.0		
COMPONENT TOTAL			18.4		144.5	100.0	2661.5	100.0		
26019 TAIL ROTOR GEAR BOX										
REPLACE	ON	O	20.8		24.6	57.5	511.9	56.2	1	1
170 CORRODED				*	9.6	22.5				
190 CRACKED				*	4.3	10.0				
374 INTERNAL FAILURE				*	1.1	2.5				
381 LEAKING-INTERN/EXTER				*	1.1	2.5				
799 NO DEFECT				*	2.1	5.0				
800 NO-DEF/OTHER MAINT				*	2.1	3.0				
803 NO-DEF/TIME CHANGE				*	4.3	10.0				
CHECK	ON	O	35.8		4.3	10.0	157.3	17.3	3	2
799 NO DEFECT				*	2.1	5.0				
804 NO-DEF/SCHED MAINT				*	2.1	5.0				
CHECK	OFF	O	8.1		4.2	9.9	34.2	3.8	4	4
799 NO DEFECT				*	2.1	4.9				
800 NO-DEF/OTHER MAINT				*	1.1	2.5				
REPAIR	OFF	O	24.0		5.3	12.5	128.4	14.1	2	3
306 CONTAMINATION				*	1.1	2.5				
350 INSULATION BREAKDOWN				*	1.1	2.5				
381 LEAKING-INTERN/EXTER				*	1.1	2.5				
602 FAIL DUE ASSOC EQUIP				*	1.1	2.5				
OTHER			18.1		4.3	10.1	78.3	8.6		
COMPONENT TOTAL			21.3		42.8	100.0	910.1	100.0		

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
26029 BEARING										
REPLACE	ON	O	4.7		79.2	97.4	372.1	75.2	1	1
020 WORN, CHAFED, FRAYED				*	7.8	9.5				
117 DETERIORATED				*	3.2	4.0				
374 INTERNAL FAILURE				*	10.4	12.8				
381 LEAKING-INTERN/EXTER				*	39.0	48.0				
799 NO DEFECT				*	3.2	4.0				
803 NO-DEF/TIME CHANGE				*	10.4	12.8				
CHECK	ON	O	1.9		1.1	1.4	2.1	0.4	2	2
OTHER			114.6		1.0	1.3	120.3	24.3		
COMPONENT TOTAL			6.1		81.3	100.0	494.6	100.0		
26040 ROTOR BRAKE SEAL										
REPLACE	ON	O	9.2		27.6	78.8	255.5	94.0	1	1
020 WORN, CHAFED, FRAYED				*	2.2	6.3				
127 ADJST/ALIGN IMPROPER				*	2.2	6.3				
381 LEAKING-INTERN/EXTER				*	23.6	67.0				
CHECK	ON	O	2.7		7.5	21.2	20.3	7.5	2	2
COMPONENT TOTAL			7.8		35.3	100.0	276.3	100.0		
26042 INTERMEDIATE GEAR BOX										
REPLACE	ON	O	7.1		18.2	46.0	129.4	49.8	1	1
070 BROKEN				*	4.3	10.8				
170 CORRODED				*	5.2	13.0				
190 CRACKED				*	1.1	2.7				
374 INTERNAL FAILURE				*	1.1	2.7				
799 NO DEFECT				*	1.7	4.3				
800 NO-DEF/OTHER MAINT				*	1.7	4.3				
803 NO-DEF/TIME CHANGE				*	3.2	8.[illegible]				
CHECK	ON	O	1.9		4.3	10.9	8.0	3.1	3	4
CHECK	OFF	O	8.0		3.2	8.1	25.7	9.9	4	3
REPAIR	ON	O	2.8		11.8	29.8	33.0	12.7	2	2
070 BROKEN				*	1.7	4.3				
190 CRACKED				*	3.4	8.5				
381 LEAKING-INTERN/EXTER				*	1.7	4.3				
900 BURNED OR OVERHEATED				*	1.7	4.3				
935 SCORED OR SCRATCHED				*	1.7	4.3				
OTHER			30.8		2.1	5.2	63.5	24.5		
COMPONENT TOTAL			6.6		39.6	100.0	255.7	100.0		

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG AC PEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-M-R MA/ FH	R-A-M-R MH/ FH
26066 OIL PUMP										
REPLACE	ON	D	5.0		13.9	92.7	69.5	92.7	2	2
070 BROKEN				*	1.4	9.3				
381 LEAKING-INTERN/EXTER				*	1.4	9.3				
799 NO DEFECT				*	5.6	37.1				
800 NO-DEF/OTHER MAINT				*	1.4	9.3				
803 NO-DEF/TIME CHANGE				*	4.2	27.8				
OTHER			5.0		1.1	7.3	5.4	7.3		
COMPONENT TOTAL			5.0		15.0	100.0	75.0	100.0		
26083 ROTOR BRAKE SEAL										
REPLACE	ON	D	7.1		21.4	100.0	151.9	135.2	1	1
304 UNIDENTIFIED BY CODE				*	1.5	7.0				
306 CONTAMINATION				*	1.5	7.0				
381 LEAKING-INTERN/EXTER				*	18.6	87.0				
COMPONENT TOTAL			7.1		21.4	100.0	151.9	100.0		
26112 DISC ASSY										
REPLACE	ON	D	3.9		16.1	100.0	62.8	87.5	1	1
070 BROKEN				*	1.7	10.5				
092 MISMATCHED				*	1.7	10.5				
170 CORRODED				*	1.7	10.5				
190 CRACKED				*	1.7	10.5				
780 BENT,BUCKLED,ETC				*	5.1	31.5				
799 NO DEFECT				*	4.3	26.7				
OTHER			3.9		0.0	0.0	9.0	12.5		
COMPONENT TOTAL			4.5		16.1	100.0	71.9	100.0		
26224 SHAFT ASSY,TAIL ROTOR										
REPLACE	ON	D	2.6		9.7	100.7	25.2	117.9	1	1
425 NICKED				*	4.3	44.7				
910 CHIPPED				*	4.3	44.7				
COMPONENT TOTAL			2.6		9.7	100.0	25.2	100.0		

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	MH/ FH
26260 CHIP DETECTOR										
REPLACE	ON	O	1.6		3.2	33.3	5.1	31.3	2	2
070 BROKEN				*	1.1	11.1				
190 CRACKED				*	1.1	11.1				
799 NO DEFECT				*	1.1	11.1				
REPAIR	ON	O	1.8		5.3	55.6	9.4	57.5	1	1
070 BROKEN				*	2.1	22.2				
190 CRACKED				*	1.1	11.1				
255 NO OUTPUT				*	1.1	11.1				
OTHER			1.7		1.1	11.1	1.8	11.1		
COMPONENT TOTAL			1.7		9.6	100.0	16.4	100.0		
26329 SHAFT ASSY,TAIL ROTOR										
REPLACE	ON	O	2.5		5.3	99.1	13.4	142.0	1	1
020 WORN,CHAFED,FRAYED				*	1.1	19.8				
458 OUT OF BALANCE				*	1.1	19.8				
800 NO-DEF/OTHER MAINT				*	3.2	59.4				
OTHER			0.0		0.0	0.9	0.0	0.0		
COMPONENT TOTAL			2.5		5.4	100.0	13.4	100.0		
42134 GENERATOR										
REPLACE	ON	O	2.0		34.2	91.4	68.5	123.1	1	1
800 NO-DEF/OTHER MAINT				*	4.3	11.4				
070 BROKEN				*	10.0	26.6				
190 CRACKED				*	2.0	5.4				
255 NO OUTPUT				*	2.0	5.4				
374 INTERNAL FAILURE				*	4.0	10.6				
58[illegible] SHEARED				*	4.0	10.6				
800 NO-DEF/OTHER MAINT				*	2.1	5.5				
OTHER			0.0		3.2	8.6	0.0	0.0		
COMPONENT TOTAL			1.8		37.4	100.0	68.5	100.0		

TABLE XXXIX - Continued

ACTION REASON/FAILURE MODE	ON/ OFF A/C	L E V	MH/ MA AVG	AVG NO MEN	MA/ FH RATE	MA/ FH PCNT	MH/ FH RATE	MH/ FH PCNT	R-A-N-K MA/ FH	R-A-N-K MH/ FH
45010 MAIN ROTOR SERVO UNITS										
REPLACE	ON	D	3.2		40.7	36.9	130.1	4.6	3	3
020 WORN,CHAFED,FRAYED				*	4.7	4.2				
381 LEAKING-INTERN/EXTER				*	9.4	8.5				
799 NO DEFECT				*	7.8	7.1				
803 NO-DEF/TIME CHANGE				*	12.5	11.4				
CHECK	OFF	D	1.5		353.1	320.4	543.6	19.2	1	2
730 LOOSE				*	21.5	19.5				
799 NO DEFECT				*	203.4	184.6				
800 NO-DEF/OTHER MAINT				*	32.1	29.2				
REPAIR	OFF	D	16.0		117.7	106.8	1883.2	66.5	2	1
029 CURRENT INCORRECT				*	10.7	9.7				
070 BROKEN				*	10.7	9.7				
111 BURST OR RUPTURED				*	10.7	9.7				
374 INTERNAL FAILURE				*	10.7	9.7				
381 LEAKING-INTERN/EXTER				*	21.4	19.4				
710 BRG FAILING/FAULTY				*	10.7	9.7				
OTHER			16.0		0.0	0.0	276.0	9.7		
COMPONENT TOTAL			5.5		511.5	100.0	2832.9	100.0		
57027 AFSC SERVO CYLINDER										
REPLACE	ON	D	7.1		7.5	33.3	53.2	9.3	1	2
374 INTERNAL FAILURE				*	1.3	5.6				
803 NO-DEF/TIME CHANGE				*	6.2	27.8				
CHECK	OFF	D	8.0		5.3	23.8	42.8	7.5	2	3
799 NO DEFECT				*	2.1	9.5				
800 NO-DEF/OTHER MAINT				*	1.1	4.8				
REPAIR	OFF	D	16.0		5.3	23.8	85.6	15.0	3	1
127 ADJST/ALIGN IMPROPER				*	1.1	4.8				
374 INTERNAL FAILURE				*	2.1	9.5				
OTHER			90.9		4.3	19.0	389.0	68.2		
COMPONENT TOTAL			25.4		22.5	100.0	570.5	100.0		
57420 AFSC AMPLIFIER										
REPLACE	ON	O	1.1		2.1	100.0	2.4	55.1	1	1
020 WORN,CHAFED,FRAYED				*	1.1	50.0				
OTHER			1.1		0.0	0.0	1.9	44.9		
COMPONENT TOTAL			2.0		2.1	100.0	4.3	100.0		